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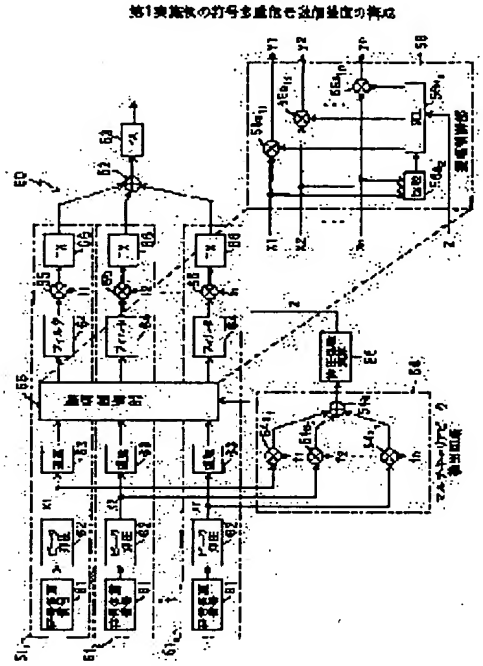
(54) CODE MULTIPLEX SIGNAL TRANSMISSION APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To improve efficiency of a power amplifier and to prevent deterioration of individual code multiplex signals, by suppressing the peaks of carrier multiplex signals.
SOLUTION: A detection section (54) for detecting the peak of a carrier multiplex signal is provided, in parallel with a main signal system; an amplitude control section (56) monitors the amplitude of the carrier multiplex signal; and when the amplitude of the signal exceeds the pre-set value, the section (56) suppresses the amplitude of the code multiplex signal before being carrier-multiplexed in the main signal system to suppress the peak of the carrier multiplex signal. The section (56) executes the steps of: (1) selecting a plurality of signals, each having a maximum amplitude or having a large amplitude from among the code multiplex signals, and (2) when the amplitude exceeds the pre-set value, multiplying the code multiplex signal selected in the step (1) by a suppression coefficient to suppress the peak of the carrier multiplex signal.



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CLAIMS

[Claim(s)]
[Claim 1] In the sign multiple-signal sending set which carries out carrier multiplex [of the sign multiple signal], amplifies this carrier multiple signal, and is transmitted Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this — the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits — When the amplitude of the 2nd carrier multiple signal which outputs said two or more sign multiple signals from the 2nd carrier multiplex circuit which carries out carrier multiplex, and said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. Said amplitude control section When the amplitude of the selection section which chooses the large sign multiple signal of the effect which it has on the peak value of the 2nd carrier multiple signal, and the 2nd carrier multiple signal exceeds the set point, The sign multiple-signal sending set characterized by having the signal oppression section which carries out the multiplication of the oppression multiplier to said selected sign multiple signal, and oppresses the peak of the 1st carrier multiple signal.
[Claim 2] In the sign multiple-signal sending set which carries out carrier multiplex [of the sign multiple signal], amplifies this carrier multiple signal, and is transmitted Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this — the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits — When the amplitude of the 2nd carrier multiple signal which outputs said two or more sign multiple signals from the 2nd carrier multiplex circuit which carries out carrier multiplex, and said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. Said amplitude control section The oppression multiplier decision section which determines the oppression multiplier which oppresses the amplitude of said sign multiple signal when the amplitude of the 2nd carrier multiple signal exceeds the set point, When the amplitude of the weighting section which performs weighting of an oppression multiplier according to the amplitude of each sign multiple signal, and said 2nd carrier multiple signal exceeds the set point, The sign multiple-signal sending set characterized by having the signal oppression section which carries out the multiplication of said oppression multiplier by which weighting was carried out to said each sign multiple signal, and oppresses the peak of the 1st carrier multiple signal.
[Claim 3] In the sign multiple-signal sending set which carries out carrier multiplex [of the sign multiple signal], amplifies this carrier multiple signal, and is transmitted Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this — the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits — When the amplitude of the 2nd carrier multiple signal which outputs said two or more sign multiple signals from the 2nd carrier multiplex circuit which carries out carrier multiplex, and said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. Said amplitude control section Difference is divided equally. the operation part which calculates the difference of the amplitude of this carrier multiple signal, and the set point when the amplitude value of the 2nd carrier multiple signal exceeds the set point -- this — Or when the amplitude of a means to carry out weighting, to distribute according to the amplitude of a sign multiple signal, and to generate an amplitude oppression signal, and said 2nd carrier multiple signal exceeds the set point, The sign multiple-signal sending set characterized by having the signal oppression section which subtracts said amplitude oppression signal and oppresses the peak of a carrier multiple signal from said each sign multiple signal.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the sign multiple-signal sending set which carries out carrier multiplex [of two or more sign multiple signals], and is transmitted especially with respect to a sign multiple-signal sending set.
[0002]
[Description of the Prior Art] The wireless access method using the code division multiple access (CDMA:CodeDivision Multiple Access) method as a next-generation digital migration communication mode is examined. A CDMA method is the point-to-multipoint connection approach which used spread spectrum communication, with a sign, carries out multiplex [of the transmission information on two or more channels (user)], and transmits it through transmission lines, such as a wireless circuit.
[0003] Drawing 15 is the conventional block diagram of the CDMA transmitter which carries out sign multiplex [of the transmit data of an n channel], and transmits it. The inside of drawing, 111-11n -- respectively -- the 1- the serial data D1-Dn of the n-th channel -- every 1 bit -- alternation -- distributing -- I component (In-Phase compornent) data Dij (j= 1, 2, ... n) and Q component () [Quadrature] The serial / parallel-conversion section changed into two sequences of the compornent data Dqj (j= 1, 2, ... n) (S/P transducer), The diffusion circuit which carries out the multiplication of the diffusion sign sequences Cij and Cqj to the data Dij and Dqj of two sequences each 121-12n, The synthetic section which 13i compounds the diffusion modulating signal of I component outputted from each diffusion circuits 121-12n, and outputs the sign multiple signal VI of I component, 13q is the synthetic section which compounds the diffusion modulating signal VQ of Q component outputted from each diffusion circuits 121-12n, and outputs the sign multiple signal of Q component, and constitutes the sign multiple-signal generation section 10 by the above.
[0004] In a filter 14, 14i and 14q are chip plastic surgery filters which restrict I of a sign multiple signal, and the band of Q component, and 15i and 15q are DA converters which carry out the DA translation of the output of each filters 14i and 14q in DA converter 15. It is the power amplifier inputted into the quadrature modulation machine which 16 gives quadrature modulation to the sign multiple signals VI and VQ of I and Q component, and is outputted, and the antenna which 17 amplifies a quadrature modulation machine output and does not illustrate. The quadrature modulation machine 16 carries out the multiplication of the carrier signal cosomegat to the output signal of DA converter 15i, carries out the multiplication of -sinomegat to the output signal of DA converter 15q, and compounds and outputs each multiplication result.
[0005] In a CDMA method, since the amplitude (output of the synthetic sections 13i and 13q of drawing 15) of a sign multiple signal serves as the electrical-potential-difference sum of the signature (the number of channels, or the number of users) which carries out multiplex, the maximum electric power Pmax is proportional to the square of a multiplex number. That is, the output of each diffusion circuit is +1 or -1, the maximum amplitude of a sign multiple signal when +1 is outputted is set to n from all the diffusion circuits of an n channel, and maximum electric power is proportional to n2. On the other hand, mean power Pmean is proportional to multiplex [several n]. As mentioned above, the peak factor (= Pmax/Pmean) of a sign multiple signal when there is multiplex [much / several n] becomes large.
[0006] Generally, in radio, the frequency band used for a communication link is restricted. For this reason, it is necessary to suppress low expansion (increase of spurious radiation power) of the frequency spectrum by the nonlinear distortion of power amplifier 17 (drawing 15). That is, since expansion of frequency spectrum becomes causes, such as contiguity active jamming, it is necessary to suppress the expansion low. When amplifying a sign multiple signal with power amplifier from this demand, it is necessary to make it have to operate in a linearity field, and the big output back off must be taken. However, if the output back off is enlarged, the problem degraded remarkably will produce the power efficiency of power amplifier. On the other hand, if sufficient output back off is not taken, expansion of spectrum is produced by nonlinear distortion of power amplifier, and the problem on which the frequency use effectiveness of a system is reduced arises.
[0007] Drawing 16 is the AM-AM property (input control power/gain characteristics) of power amplifier, and drawing 17 is the example of the AM-PM property (input control power/phase characteristic) of power amplifier. While input control power of power amplifier is small, gain characteristics and a phase characteristic are flats, and the input-output behavioral characteristics are linearity, and do not carry out phase rotation, either. However, if it becomes more than level with input control power, while gain will begin to become small, phase lag occurs, and each property

becomes nonlinear. The output power level in which gain fell by 1dB is called 1dB compression level, and the difference of this level and an average power output is the output back off OBO. In this nonlinear amplifier, even if the mean power level of an input signal exists in the linearity part, by the balance of the output back off OBO and a peak factor, 1dB compression level is exceeded, distortion occurs, and frequency spectrum expands the signal of the maximum power level or the level near it. As mentioned above, in a CDMA transmitter, since the peak factor is very large, this problem is serious.

[0008] Then, when the mean power level of an input signal is lowered and the output back off OBO is enlarged so that 1dB compression level may not be exceeded at the time of input signal arrival of the maximum power level, distortion does not arise but there is also no expansion of frequency spectrum. However, lowering mean power level reduces the power efficiency of power amplifier. As mentioned above, when the mean power level of an input signal was lowered conventionally and expansion of the distortion in power amplifier (the output back off OBO is large) or frequency spectrum was prevented, the power efficiency of power amplifier declined, and when the power average level of an input signal was raised and the effectiveness of power amplifier (the output back off OBO is small) was gathered, the distortion in power amplifier occurred, and there was a problem which frequency spectrum expands conversely. Moreover, DA converters 15i and 15q are required of the configuration which generates a sign multiple signal by digital signal processing as shown in drawing 15 . The quantifying bit number of this DA converter is limited, and the full scale is set up so that the maximum of a sign multiple signal can be outputted. However, in a CDMA transmitter, since the peak factor of a sign multiple signal is very large, the number of effective bits to the signal of the mean power circumference with high occurrence frequency decreases, and a quantization noise becomes large. Degradation by this quantization degrades the noise floor of for example, a spectrum property etc., and causes contiguity active jamming.

[0009] As mentioned above, the sign multiple-signal sending set which formed the signal peak oppression section 20 which oppresses the peak value of a composite signal as shown in drawing 18 is proposed (JP,10-178414,A). In addition, in drawing 18 , the same sign is given to the same part as drawing 15 . The signal peak oppression section 20 detects the envelope of a sign multiple signal, compares an envelope value with setting level, and when an envelope value is more than setting level, it oppresses peak value by asking for the attenuance which makes this envelope value setting level, and carrying out the multiplication of this attenuance to the sign multiple signals VI and VQ. As mentioned above, even if it can make a peak factor small, consequently the output back off OBO is small by oppressing the peak value of a sign multiple signal, the maximum power level of an output signal can be prevented from exceeding 1dB compression level. That is, the effectiveness of power amplifier can be improved and, moreover, distorted generating and expansion of frequency spectrum can be prevented. Moreover, the maximum output amplitude of a filter 14 is used as the full scale of DA converter 15. Even if such, since the peak factor is small, the number of effective bits to the signal of the mean power circumference with high occurrence frequency can be made [many], and the noise floor of output spectrum can be reduced, and the necessary number of bits of a DA converter can be reduced.

[0010]

[Problem(s) to be Solved by the Invention] Although the base station equipment treating two or more channels generates the signal by which sign multiplex was carried out as mentioned above, the function which carries out carrier multiplex [of further two or more sign multiple signals], and is transmitted according to increase of the number of channels which carries out multiplex is required. Drawing 19 is the block diagram of the sign multiple-signal sending set which carries out carrier multiplex [of two or more of these sign multiple signals], and is transmitted, carries out n carrier part multiplex [of the sign multiple signal], and has the transmitted configuration which carries out power amplification. 11-1n are the sign multiple-signal transmitting sections for one carrier, respectively, has the configuration of drawing 18 and abbreviation identitas, and gives the same sign to the same part. in addition -- a sign -- a multiple signal -- transmission -- the section -- 11 - one -- n -- setting -- a DA converter -- illustration -- omitting -- replacing -- each -- quadrature modulation -- a signal -- a RF -- a signal -- frequency conversion -- carrying out -- a sending circuit -- (-- TX --) -- 22 -- adding -- having -- **** . Quadrature modulation of the each sign multiple-signal transmitting sections [11-1n] quadrature modulation section 16 is carried out with the carrier signal of the frequencies f1-fn of deltaf spacing. The synthetic section 18 carries out carrier multiplex [of the sending signal outputted from each sign multiple-signal transmitting sections 11-1n], inputs it into power amplifier 17, and power amplifier amplifies the sending signal by which carrier multiplex was carried out, and it emits it from an antenna.

[0011] Although the sign multiple-signal sending set of drawing 19 can oppress the peak of each sign multiple signal in each sign multiple-signal transmitting section 11-1n, it is not oppressing the peak produced in carrier multiplex. For this reason, the peak factor of the carrier multiple signal finally amplified with power amplifier 17 becomes large, and there is a problem which falls the effectiveness of power amplifier. Then, although it is possible to perform direct peak oppression to a carrier multiple signal, the strain of the signal by oppression degrades spectral characteristics. Moreover, by the method which performs peak oppression after detecting the amplitude of a carrier multiple signal, after the signal before peak oppression has already inputted into power amplifier, namely, the signal before peak oppression inputs into power amplifier, in order to carry out peak oppression, peak oppression control becomes slow.

[0012] As mentioned above, without degrading the spectral characteristics of a carrier multiple signal, the purpose of this invention can oppress the peak of a carrier multiple signal, and, moreover, is making it the signal before peak oppression not input into power amplifier. Although another purpose of this invention controls the amplitude of each

sign multiple signal and oppresses the peak of a carrier multiple signal, even if it is this case, it is preventing signal degradation (degradation of modulation precision) of the sign multiple signal of small-size width of face. Another purpose of this invention is to enable big peak oppression by controlling the band limit filter of a peak oppression signal independently of the band control filter of the main signal system.
[0013]
[Means for Solving the Problem] It is the sign multiple-signal sending set which this invention carries out carrier multiplex [of the sign multiple signal], amplifies this carrier multiple signal, and is transmitted. (1) Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this — the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits — (2) The 2nd carrier multiplex circuit and (3) which carry out carrier multiplex [of said two or more sign multiple signals] When the amplitude of the 2nd carrier multiple signal outputted from said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. When the sign multiple signal which has big effect on the peak value of a carrier multiple signal, for example, a sign multiple signal with the big amplitude, is chosen and the amplitude of the 2nd carrier multiple signal exceeds the set point, the 1st amplitude control section of this invention carries out the multiplication of the oppression multiplier to the this chosen sign multiple signal, and oppresses the peak of the 1st carrier multiple signal.
[0014] When the oppression multiplier which oppresses the amplitude of each sign multiple signal when the amplitude of the 2nd carrier multiple signal exceeds the set point is determined, weighting of an oppression multiplier is performed according to the amplitude of each sign multiple signal and the amplitude of the 2nd carrier multiple signal exceeds the set point, the 2nd amplitude control section of this invention carries out the multiplication of the oppression multiplier by which weighting was carried out to each sign multiple signal, and oppresses the peak of the 1st carrier multiple signal. the time of the amplitude value of the 2nd carrier multiple signal exceeding the set point, as for the 3rd amplitude control section -- the difference of the amplitude value of this carrier multiple signal, and the set point — calculating — this — difference is equally divided to each sign multiple signal, or according to the amplitude of a sign multiple signal, weighting is carried out, it distributes, and an amplitude oppression signal is generated, from each sign multiple signal, an amplitude oppression signal is subtracted and the peak of a carrier multiple signal is oppressed.
[0015] As mentioned above, according to this invention, it sets to peak oppression of a carrier multiple signal. The carrier multiplex circuit different from the carrier multiplex section of the main signal system for peak detection is prepared. Since the peak of a carrier multiple signal is detected using this and the signal amplitude in front of carrier multiplex was controlled The peak of a carrier multiple signal can be oppressed, since peak detection time can be shortened according to this invention, the short-time delay section is prepared and the signal before peak oppression can be prevented from moreover inputting into power amplifier, without degrading the spectral characteristics of a carrier multiple signal. Moreover, when according to this invention controlling the amplitude of each sign multiple signal and oppressing the peak of a carrier multiple signal, in order to carry out weighting of the amount of oppression based on the magnitude of the amplitude which only a sign multiple signal with the big amplitude which affects a peak carries out amplitude oppression, or affects a peak, the sign multiple signal of small-size width of face does not deteriorate by peak oppression control of a carrier multiple signal (degradation of modulation precision).
[0016] Moreover, peak oppression can be easily performed by constituting so that oppression may carry out the multiplication of the oppression multiplier to the sign multiple signal of required time of day and the peak value of a carrier multiple signal may be oppressed. Moreover, with the configuration which subtracts a peak oppression signal from a sign multiple signal, a bigger peak oppression is attained by permitting degradation of some spectrum by controlling the band limit filter of a peak oppression signal independently of the band control filter of the main signal system, and setting the band limit filter of a peak oppression signal as a suitable property.
[0017]
[Embodiment of the Invention] (A) 1st example drawing 1 is the block diagram of the sign multiple-signal sending set which is the 1st example of this invention which carries out carrier multiplex [of two or more sign multiple signals], and is transmitted, carries out n carrier part multiplex [of the sign multiple signal], and has the transmitted configuration which carries out power amplification. The adder unit which the sign multiple-signal transmitting section for one carrier and 52 add the RF signal for n carrier outputted from each sign multiple-signal transmitting section 511-51n, respectively, and is outputted, and 53 are power amplifier which amplifies the multiple signal for n carrier and is inputted into an antenna (not shown). The sign multiple-signal transmitting sections 511-51n and an adder unit 52 constitute the 1st carrier multiplex circuit 50 of the main signal system. The multi-carrier peak detector of a peak detection system where 54 carries out carrier multiplex [of each sign multiple signal] for peak detection (2nd carrier multiplex circuit), When 55 supervises the amplitude of the carrier multiple signal outputted from the multi-carrier peak detector 54 of 2 and this signal amplitude exceeds the set point, the oppression multiplier operation part which outputs the oppression multiplier z, and 56 -- the oppression multiplier z and each sign multiple-signal x1 (t) - it is the amplitude control section which oppresses the amplitude of each sign multiple signal based on the amplitude value of xn (t).
[0018] 511-51n of sign multiple-signal transmitting sections is equipped with the same configuration, and the sign multiple-signal generation section 61 compounds two or more diffusion data diffused with the predetermined sign, respectively, and outputs a sign multiple signal. The peak oppression section 62 detects the envelope of a sign

multiple signal, compares an envelope value with setting level, and when an envelope value is more than setting level, it oppresses peak value by asking for the attenuance which makes this envelope value setting level, and carrying out the multiplication of this attenuance to a sign multiple signal. The delay section 63 is delayed in time amount until the oppression multiplier which decreases the peak of a carrier multiple signal can be found, and the output signal of the peak oppression section 62.

[0019] A filter 64 is a chip plastic surgery filter which restricts the band of the sign multiple signal which is outputted from the amplitude control section 56, and by which amplitude control was carried out. Spectrum distribution of a sign multiple signal should be shown as the continuous line SPC of drawing 2 (a). It has a sinc curvilinear configuration and the band more than I/Tc (Tc is a chip period) is unnecessary. Then, the filter which has the frequency characteristics shown by the dotted line A band-limits. B is the frequency characteristics of an ideal filter. By the way, it is necessary to make it the synthetic property of a filter prepared in a transmitter and each receiver become the dotted line A of drawing 2 (a) in wireless. Then, the approach of distributing so that root roll-off-characteristics C shown at drawing 2 (b), respectively may be set to the chip plastic surgery filter 64 and the synthetic filter shape of a transceiver machine may turn into the property A shown in drawing 2 (a) or drawing 2 (c) is common.

[0020] The frequency shift section 65 carries out the multiplication of the carrier frequencies f1-fn to a sign multiple signal, and carries out a frequency shift. As drawing 15 explained, specifically, the frequency shift section 65 consists of the quadrature modulation sections (QMOD). The quadrature modulation section carries out the multiplication of the carrier signal cosomegait to I component of the sign multiple signal outputted from the sign multiple-signal generation section 61, carries out the multiplication of -sinomegait to Q component, and compounds and outputs each multiplication result. A sending circuit 66 carries out frequency conversion of the output of the quadrature modulation section 65 to a RF signal, and inputs it into an adder 52. In addition, although frequency conversion of the output signal of each quadrature modulation machine 65 is separately carried out to the RF signal by a diagram, the output signal of each quadrature modulation section can be compounded, and it can also constitute so that frequency conversion of the synthetic modulating signal may be carried out in one sending circuit (TX) and it may input into an adder unit 52.

[0021] the multi-carrier peak detector 54 -- setting -- frequency shift section 54a1-54an -- the sign multiple signal x1 (t), x2 (t), and ... carrying out the multiplication of the carrier frequencies f1-fn to xn (t), a frequency shift is carried out, and synthetic section 54b carries out frequency multiplex [of each sign multiple signal by which the frequency shift was carried out], and outputs a carrier multiple signal. the sign multiple signal x1 (t), x2 (t), and ... if xn (t) is digital -- frequency shift section 54a1-54an -- the sign multiple signal x1 (t), x2 (t), and ... xn (t) -- exp (jomegaone t), exp (jomegatwo t), and ... the multiplication of the exp (jomegant) (omegan=2pifn) is carried out, and a frequency shift is given. Since the sign multiple signal of each carrier is given as a sample train of the chip time amount Tc, the multi-carrier peak detector 54 performs a frequency multiplex operation as an impulse train as shows this to drawing 3 (A).

[0022] The oppression multiplier operation part 55 will output the oppression multiplier z= 1, if a carrier multiple signal is below set point upsilonc, and with [operation part] the set point [beyond], it outputs the predetermined oppression multiplier z (<1). Specifically, it asks for an oppression multiplier by (1) and (2) types. The sign multiple signal after xi (t) and amplitude oppression is set to yi (t) for a sign multiple signal among a formula. Here, x and y is [real number and omegai of complex (equivalence baseband expression) and g] the angular frequency of a carrier. yi (t) = {g(|z (t) |)/|z(t) |}, xi (t) (1) | z(t) |=sigmaixi(t) exp (jomegait) (i= 1 - N) (2) Here, g (|z (t) |) is a function which controls oppression, and, in the case of a hard clip which hangs a limiter on an envelope by threshold level upsilonc, is given by (3a) and the formula (3b).

g(|z (t) |) =|z| In the case of |z|<=upsilonc (3a) g(|z (t) |) =upsilonc In the case of |z|>upsilonc (3b) In addition, the oppression multiplier z is given by degree type z=g(|z (t) |)/|z(t) |.

[0023] In the amplitude control section 56, 56a11 to 56a1n of multiplication sections carries out the multiplication of the oppression multiplier to each sign multiple signal xi (t). A comparator 56a2 compares the amplitude of each sign multiple signal, and determines two or more large signals of the effect which it has on the peak value of a carrier multiple signal, for example, the sign multiple signal of max [amplitude], and big sign multiple signals of the amplitude. If the selection section 56a3 is the oppression multiplier z= 1, it will input the oppression multiplier z= 1 into 56a11 to 56a1n of each multiplication section. Consequently, the multiplication section output is the same as an input, and oppresses neither of the sign multiple signals. However, if the selection section 56a3 is the oppression multiplier z< 1, the amplitude will input this oppression multiplier z into the multiplication section according to max or two or more sign multiple signals with the big amplitude, and it will input 1 into other multiplication sections. Consequently, signal amplitude is oppressed only for a sign multiple signal with the large effect which it has on the peak value of a carrier multiple signal, and the peak of a multi-carrier is oppressed. In this case, since the small sign multiple signal of the effect which it has on the peak value of a carrier multiple signal is not oppressed, it is effective in the ability to prevent signal degradation (degradation of modulation precision) of this small-size width-of-face signal.

[0024] - Modification drawing 4 of the 1st example is the 1st modification of the 1st example, and gives the same sign to the same part as the 1st example of drawing 1 . a different point -- the multi-carrier peak detecting-element 54 interior -- step-izing -- section 54c1-54cn is prepared, as shown in drawing 3 (B), the exaggerated sample of the sign multiple signal of each carrier is carried out, and it changes into a step function, and is the point of performing a frequency shift and a frequency multiplex operation, after an appropriate time.

[0025] Drawing 5 is the 2nd modification of the 1st example, and gives the same sign to the same part as the 1st example of drawing 1 . A different point prepares filter 54d1-54dn in the multi-carrier peak detecting-element 54 interior, carries out the exaggerated sample of the sign multiple signal of each carrier, shapes it in waveform with a filter, and is a point of performing a frequency shift and a frequency multiplex operation, after an appropriate time. By using the same properties (for example, root REIZU docosa in etc.) as the filter 64 of a sending-signal system for filter 54d1-54dn, the peak of an exact carrier multiple signal is detectable. However, delay becomes large. By on the other hand using a simple property (convergence of an impulse response being early) for filter 54d1-54dn, the peak of a carrier multiple signal more exact than a step function can be detected, and, moreover, delay can be made small.

[0026] - Modification drawing 6 of an amplitude control section and drawing 7 are the modifications of the amplitude control section 56, and these amplitude control sections choose the output to which oppression carried out the multiplication of the oppression multiplier to the sign multiple signal of required time of day, and carry out the selection output of the signal of the origin which is not oppressed to the signal of the time of day when oppression is unnecessary. In the amplitude control section of drawing 6 , 56b11 to 56b1n of multiplication sections carries out the multiplication of the oppression multiplier z to each sign multiple signal xi (t). A comparator 56b2 compares the amplitude of each sign multiple signal xi (t), and it determines to be the signal which should oppress the large signal of the effect which it has on the peak value of a carrier multiple signal, for example, the sign multiple signal of max [amplitude], and two or more big sign multiple signals of the amplitude. Setting in this condition, a comparator 56b2 is (1). When it is not oppression timing (at the time of amplitude oppression needlessness), It points so that each sign multiple signal xi (t) may be outputted as it is to 56b31 to 56b3n of selectors. (2) At the time of oppression timing (at the time of the amplitude oppression need), it points so that a multiplier output may be chosen to the selector according to the sign multiple signal which should be oppressed, and it directs to output the sign multiple signal xi (t) as it is to the other selector. Consequently, that to which 56b31 to 56b3n of selectors was outputted as it was at the time of amplitude oppression needlessness, without oppressing each sign multiple signal xi (t), and they outputted the sign multiple signal with the small amplitude as it was at the time of the amplitude oppression need, without oppressing, and oppressed the sign multiple signal of max [amplitude] or two or more big sign multiple signals of the amplitude is outputted.

[0027] Oppression timing signal ALS is outputted from the oppression multiplier operation part 55 (drawing 1). That is, the oppression multiplier operation part 55 does not generate oppression timing signal ALS while outputting the oppression multiplier z= 1, if the amplitude of a carrier multiple signal is below set point upsilonc, but it outputs oppression timing signal ALS while it outputs the predetermined oppression multiplier z (<1) with [operation part] the set point [beyond].

[0028] In the amplitude control section of drawing 7 , 56c11 to 56c1n of multiplication sections carries out the multiplication of the oppression multiplier z or 1 to each sign multiple signal xi (t). A comparator 56c2 compares the amplitude of each sign multiple signal xi (t), and it determines to be the signal which should oppress the large signal of the effect which it has on the peak value of a carrier multiple signal, for example, the sign multiple signal of max [amplitude], and two or more big sign multiple signals of the amplitude. Setting in this condition, a comparator 56c2 is (1). When it is not oppression timing (at the time of amplitude oppression needlessness), It points so that 1 may be chosen to 56c31 to 56c3n of selectors, and it is (2). At the time of oppression timing (at the time of the amplitude oppression need), it points so that the oppression multiplier z may be chosen to the selector according to the sign multiple signal which should be oppressed, and it directs to choose 1 to the other selector. Consequently, what outputted 56c11 to 56c1n of multiplication sections as it was at the time of amplitude oppression needlessness, without oppressing each sign multiple signal xi (t), and the sign multiple signal with the small amplitude was outputted as it was at the time of the amplitude oppression need, without oppressing, the sign multiple signal of max [amplitude] or two or more big sign multiple signals of the amplitude carried out the multiplication of the oppression multiplier z, and they oppressed is outputted.

[0029] (B) 2nd example drawing 8 is the block diagram of the 2nd example of this invention which carries out carrier multiplex [of two or more sign multiple signals], and is transmitted, and gives the same sign to the same part as the 1st example of drawing 1 . A different point is the configuration of the amplitude control section 56. The amplitude control section 56 is equipped with the configuration which carries out weighting of the peak oppression multiplier z for which it asked by the oppression multiplier operation part 55 with the amplitude or power of each carrier signal, and carries out multiplication to each carrier. Namely, 56d of oppression multiplier weighting sections, the amplitude of each sign multiple signal xi (t) is compared, and, as for 1, a larger (the signal amplitude like a signal with the large effect to the peak value of a carrier multiple signal (i.e., signal amplitude)) sign multiple signal determines weight to which the oppression multiplier z becomes small. For example, since it is one or less, value z-w which hung weight w on the oppression multiplier z is set to w<=1/z, and if it is z= 0.8, it will be set to w<=1.25. Therefore, weight is divided into a three-stage with the amplitude as an example, and weight of 1.0 and a small-size width-of-face signal is set [weight w of a large amplitude signal] to 1.20 for weight w of 0.8 and an inside amplitude signal.

[0030] 56d of weighting sections, 1 will input 1 into multiplication section [56d / 21-56d] 2 n as it is, without carrying out weighting, if the oppression multiplier z is 1. Consequently, the multiplication section output is the same as an input, and oppresses neither of the sign multiple signals. However, if it is z< 1, 1 will input into multiplication section [56d / 21-56d] 2 n what applied weight wi to the oppression multiplier z 56d of weighting sections. Consequently, signal amplitude is oppressed and the peak of a carrier multiple signal is oppressed for a sign multiple signal with the larger effect which it has on the peak value of a carrier multiple signal. In this case, since a sign

multiple signal with the small amplitude is seldom oppressed, signal degradation (degradation of modulation precision) of this small-size width-of-face signal can be prevented.
[0031] - Modification drawing 9 of an amplitude control circuit and drawing 10 are the modifications of an amplitude control section, and these amplitude control sections choose that to which oppression carried out the multiplication of the oppression multiplier to the sign multiple signal of required time of day, and carry out the selection output of the signal of the origin which is not oppressed to the signal of the time of day when oppression is unnecessary. In the amplitude control section of drawing 9 , the oppression multiplier weighting section 56e1 compares the amplitude of each sign multiple signal xi (t), and a sign multiple signal with signal amplitude larger [a signal with the larger effect to the peak value of a carrier multiple signal] determines weight to which an oppression multiplier becomes small. And the weighting section 56e1 inputs into 56e21 to 56e2n of multiplication sections what applied weight wi to the oppression multiplier z, and 56e21 to 56e2n of multiplication sections carries out the multiplication of oppression multiplier z-wi to each sign multiple signal xi (t), and it inputs them into 56e31 to 56e3n of selectors.
[0032] 56e31 to 56e3n of selectors is (1). When it is not oppression timing (at the time of amplitude oppression needlessness), each sign multiple signal xi (t) is outputted as it is, and it is (2). The multiplication result of 56e21 to 56e2n of multiplication sections is outputted at the time of oppression timing (at the time of the amplitude oppression need). That is, at the time of amplitude oppression needlessness, 56e31 to 56e3n of selectors is outputted as it is, without oppressing each sign multiple signal xi (t), and they oppress and output a sign multiple signal with the larger effect which it has on the peak value of a carrier multiple signal for signal amplitude at the time of the amplitude oppression need. Consequently, since a sign multiple signal with the small amplitude is seldom oppressed, signal degradation (degradation of modulation precision) of this small-size width-of-face signal can be prevented. Oppression timing signal ALS is outputted from the oppression multiplier operation part 55 (drawing 8). That is, the oppression multiplier operation part 55 does not generate oppression timing signal ALS while outputting the oppression multiplier z= 1, if the amplitude of a carrier multiple signal is below set point upsilonc, but it outputs oppression timing signal ALS while it outputs the predetermined oppression multiplier z (<1) with [operation part] the set point [beyond].
[0033] In the amplitude control section of drawing 10 , 56f of oppression multiplier weighting sections, 1 compares the amplitude of each sign multiple signal xi (t), and a sign multiple signal with signal amplitude larger [a signal with the larger effect to the peak value of a carrier multiple signal] determines weight to which an oppression multiplier becomes small, and it outputs what applied weight wi to the oppression multiplier z. Selector 56f21-56f2n is (1). When it is not oppression timing (at the time of amplitude oppression needlessness), 1 is chosen and it outputs to each multiplication section [56f / 31-56f] 3 n, and it is (2). The weighting oppression multiplier outputted from 1 56f of weighting sections is outputted to each multiplication section [56f / 31-56f] 3 n at the time of oppression timing (at the time of the amplitude oppression need). Consequently, at the time of amplitude oppression needlessness, 56c11 to 56c1n of multiplication sections is outputted as it is, without oppressing each sign multiple signal xi (t), and they output the signal which carried out the multiplication of the weighting oppression multiplier, and oppressed it to each sign multiple signal xi (t) at the time of the amplitude oppression need. As mentioned above, a sign multiple signal with the larger effect which it has on the peak value of a carrier multiple signal oppresses signal amplitude, and can be prevented from oppressing a sign multiple signal with the small amplitude not much at the time of the amplitude oppression need.
[0034] (C) 3rd example drawing 11 is the block diagram of the 3rd example of this invention which carries out carrier multiplex [of two or more sign multiple signals], and is transmitted, and gives the same sign to the same part as the 1st example of drawing 1 . the 3rd example -- a peak detection system -- setting -- the difference of the carrier multiple signal amplitude-limiting before and after amplitude limiting -- calculating -- this -- the common amplitude oppression signal which used difference as 1/several carriers is created, in front of the band limit filter of the main signal system, this amplitude oppression signal is subtracted from each sign multiple signal, and the peak of a carrier multiple signal is oppressed.
[0035] the multi-carrier peak detector 54 -- setting -- frequency shift section 54a1-54an -- the sign multiple signal x1 (t), x2 (t), and ... carrying out the multiplication of the carrier signal of frequencies f1-fn to xn (t), a frequency shift is carried out, and synthetic section 54b carries out frequency multiplex [of each sign multiple signal by which the frequency shift was carried out], and outputs carrier multiple-signal A-exp (jtheta). Amplitude limiting of the amplitude-limiting section 57 is carried out, and it outputs upsilonc-exp (jtheta) so that a carrier multiple signal may be set to setting amplitude upsilonc, as shown in drawing 12 . difference -- operation part 58 -- the difference of carrier multiple-signal A-exp (jtheta) and upsilonc-exp (jtheta) -- z (= (A-upsilonc) exp (jtheta)) -- calculating -- the division section 59 -- difference -- z -- 1 for the number of carriers (=n) -- it carries out, the amplitude oppression signal za (=z/n) is generated, and it inputs into the amplitude control section 56. subtraction section 56g1-56gn of the amplitude control section 56 -- each sign multiple signal x1 (t), x2 (t), and ... the amplitude oppression signal za is subtracted from xn (t), respectively, and the peak of a carrier multiple signal is oppressed.
[0036] - modification drawing 13 of an amplitude control section -- the modification of the amplitude control section 56 -- it is -- the differential signal z of drawing 11 -- the sign multiple signal x1 (t), x2 (t), and ... the amplitude value of xn (t) -- being based -- weighting -- carrying out -- each sign multiple signal x1 (t), x2 (t), and ... from xn (t), subtract the amplitude oppression signals za1-zan which carried out weighting, and oppress a peak. That is, 56h of weighting sections, 1 compares the amplitude of each sign multiple signal xi (t), and it determines and outputs weight so that an amplitude oppression signal may become [a signal with the larger effect to the peak value of a carrier multiple signal] large in a sign multiple signal with larger signal amplitude. However, it is made for total of

weight to be set to 1. Multiplication section [56h / 21-56h] 2 n carries out the multiplication of the weight to a differential signal z, and generates the weighting amplitude oppression signals za1-zan. subtraction section [56h / 31-56h] 3 n -- each sign multiple-signal x1 (t) - the amplitude oppression signals za1-zan which carried out weighting, respectively are subtracted from xn (t), and the peak of a carrier multiple signal is oppressed. A sign multiple signal with the larger effect which it has on the peak value of a carrier multiple signal oppresses signal amplitude, and can be prevented from oppressing a sign multiple signal with the small amplitude not much according to the amplitude control section of this modification. Consequently, signal degradation (degradation of modulation precision) of the sign multiple signal of small-size width of face can be prevented.

[0037] - Modification drawing 14 of the 3rd example is the modification of the 3rd example, and gives the same sign to the same part as the 3rd example of drawing 11 . 1/n Different points are the point of having formed the filter 60 for a band limit in the latter part of the division section 59 to carry out, the point of having formed the amplitude control section 56 in the latter part of the filter 64 of ** main signal system, and a point of omitting the delay section 63 (referring to drawing 11) in ** main signal system, about the ** differential signal z. In addition, naturally it is possible to add the delay section. The amplitude oppression signal za acquired by 1/n Carrying out a differential signal z by the above configuration is shaped in waveform with a filter 60. After an appropriate time, in the amplitude control section 56, from the sign multiple signal xi (t) band-limited with the filter 64 of the main signal system, the output signal of a filter 60 is subtracted and the peak of a carrier multiple signal is oppressed.

[0038] If it is made this configuration, even if overshoot occurs with the property of the filter 64 of the main signal system and it exceeds the set point, since amplitude limiting is carried out after this filter, a peak can be certainly oppressed below to the set point. Moreover, amplitude control becomes the superposition of a mere spectrum by filtering the amplitude oppression signal za, and peak oppression is attained, lessening signal degradation by designing the property of a filter 60 suitably. That is, according to the modification, bigger peak oppression can be performed by permitting degradation of some spectrum by controlling the band limit filter of a peak oppression signal independently of the band control filter of the main signal system, and setting the band limit filter of a peak oppression signal as a suitable property.

[0039] - In the sign multiple-signal sending set which carries out carrier multiplex [of the additional remark (additional remark 1) sign multiple signal], amplifies this carrier multiple signal, and is transmitted Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this -- the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits -- When the amplitude of the 2nd carrier multiple signal which outputs said two or more sign multiple signals from the 2nd carrier multiplex circuit which carries out carrier multiplex, and said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. Said amplitude control section When the amplitude of the selection section which chooses the large sign multiple signal of the effect which it has on the peak value of the 2nd carrier multiple signal, and the 2nd carrier multiple signal exceeds the set point, The sign multiple-signal sending set characterized by having the signal oppression section which carries out the multiplication of the oppression multiplier to said selected sign multiple signal, and oppresses the peak of the 1st carrier multiple signal.

[0040] In the sign multiple-signal sending set which carries out carrier multiplex [of the sign multiple signal], amplifies this carrier multiple signal, and is transmitted (Additional remark 2) Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this -- the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits -- When the amplitude of the 2nd carrier multiple signal which outputs said two or more sign multiple signals from the 2nd carrier multiplex circuit which carries out carrier multiplex, and said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. Said amplitude control section The oppression multiplier decision section which determines the oppression multiplier which oppresses the amplitude of said sign multiple signal when the amplitude of the 2nd carrier multiple signal exceeds the set point, When the amplitude of the weighting section which performs weighting of an oppression multiplier according to the amplitude of each sign multiple signal, and said 2nd carrier multiple signal exceeds the set point, The sign multiple-signal sending set characterized by having the signal oppression section which carries out the multiplication of said oppression multiplier by which weighting was carried out to said each sign multiple signal, and oppresses the peak of the 1st carrier multiple signal.

(Additional remark 3) the additional remark 1 characterized by what oppression carries out the multiplication of the oppression multiplier to required time of day to a sign multiple signal, and the peak value of a carrier multiple signal is oppressed for -- again -- the sign multiple-signal sending set of additional remark 2 publication.

[0041] In the sign multiple-signal sending set which carries out carrier multiplex [of the sign multiple signal], amplifies this carrier multiple signal, and is transmitted (Additional remark 4) Carry out carrier multiplex [of two or more sign multiple signals], and the 1st carrier multiple signal is generated. this -- the 1st carrier multiplex circuit which amplifies the 1st carrier multiple signal and transmits -- When the amplitude of the 2nd carrier multiple signal which outputs said two or more sign multiple signals from the 2nd carrier multiplex circuit which carries out carrier multiplex, and said 2nd carrier multiplex circuit is supervised and this signal amplitude exceeds the set point, It has the amplitude control section which oppresses the amplitude of said sign multiple signal in front of carrier multiplex [in the 1st carrier multiplex circuit]. Said amplitude control section Difference is divided equally. the operation part which calculates the difference of the amplitude of this carrier multiple signal, and the set point when the amplitude value of the 2nd carrier multiple signal exceeds the set point -- this -- Or when the amplitude of a means to carry

out weighting, to distribute according to the amplitude of a sign multiple signal, and to generate an amplitude oppression signal, and said 2nd carrier multiple signal exceeds the set point, The sign multiple-signal sending set characterized by having the signal oppression section which subtracts said amplitude oppression signal and oppresses the peak of a carrier multiple signal from said each sign multiple signal.
[0042] (Additional remark 5) It is the sign multiple-signal sending set of the additional remark 4 publication which said amplitude control section is equipped with the filter which shapes in waveform to said amplitude oppression signal, and is characterized by what said signal oppression section subtracts said amplitude oppression signal shaped in waveform for from each sign multiple signal outputted from the band limit filter of the 1st carrier multiplex circuit.
[0043]
[Effect of the Invention] According to this invention, in peak oppression of a carrier multiple signal, the carrier multiplex circuit different from the carrier multiplex section of the main signal system for peak detection is prepared above. Since the peak of a carrier multiple signal is detected using this and the signal amplitude in front of carrier multiplex was controlled The peak of a carrier multiple signal can be oppressed, since peak detection time can be shortened according to this invention, the short-time delay section is prepared and the signal before peak oppression can be prevented from moreover inputting into power amplifier, without degrading the spectral characteristics of a carrier multiple signal.
[0044] When according to this invention controlling the amplitude of each sign multiple signal and oppressing the peak of a carrier multiple signal, only the sign multiple signal of the large amplitude which affects a peak carries out amplitude oppression. Or in order to carry out weighting of the amount of oppression to a peak based on the magnitude of the affecting amplitude, According to this invention the sign multiple signal of small-size width of face can be prevented from deteriorating by peak oppression control of a carrier multiple signal (degradation of modulation precision) Since oppression carries out the multiplication of the oppression multiplier to the sign multiple signal of required time of day and the peak value of a carrier multiple signal was oppressed, peak oppression can be performed easily. According to this invention, since it constitutes so that a peak oppression signal may be subtracted from a sign multiple signal, and the band limit filter of a peak oppression signal is controlled independently of the band control filter of the main signal system and the band limit filter of a peak oppression signal was set as the suitable property, bigger peak oppression can be performed by permitting degradation of some spectrum.

[Translation done.]

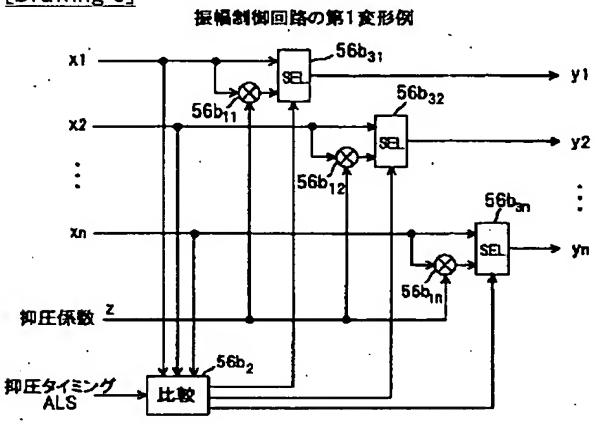
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the sign multiple-signal sending set of the 1st example which carries out carrier multiplex [of two or more sign multiple signals], and is transmitted.
[Drawing 2] It is the property explanatory view of a chip plastic surgery filter.
[Drawing 3] It is the explanatory view of a sign multiple signal.
[Drawing 4] It is the 1st modification of the 1st example.
[Drawing 5] It is the 2nd modification of the 1st example.
[Drawing 6] It is the 1st modification of an amplitude control circuit.
[Drawing 7] It is the 2nd modification of an amplitude control circuit.
[Drawing 8] It is the block diagram of the sign multiple-signal sending set of the 2nd example.
[Drawing 9] It is the 1st modification of the amplitude control circuit of drawing 8 .
[Drawing 10] It is the 2nd modification of the amplitude control circuit of drawing 8 .
[Drawing 11] It is the block diagram of the sign multiple-signal sending set of the 3rd example.
[Drawing 12] It is the explanatory view of the amplitude-limiting section of operation.
[Drawing 13] It is the modification of an amplitude control circuit.
[Drawing 14] It is the modification of the 3rd example.
[Drawing 15] It is the block diagram of the conventional CDMA transmitter.
[Drawing 16] It is the AM-AM property (input control power/gain characteristics) of power amplifier.
[Drawing 17] It is the AM-PM property (input control power/phase characteristic) of power amplifier.
[Drawing 18] It is the block diagram of the conventional sign multiple-signal sending set equipped with the peak oppression section.
[Drawing 19] It is the block diagram of the sign multiple-signal sending set which carries out carrier multiplex [of two or more conventional sign multiple signals], and is transmitted.
[Description of Notations]
511-51n Sign multiple-signal transmitting section
52 Adder Unit
53 Power Amplifier
54 Multi-Carrier Peak Detector
55 Oppression Multiplier Operation Part
56 Amplitude Control Section

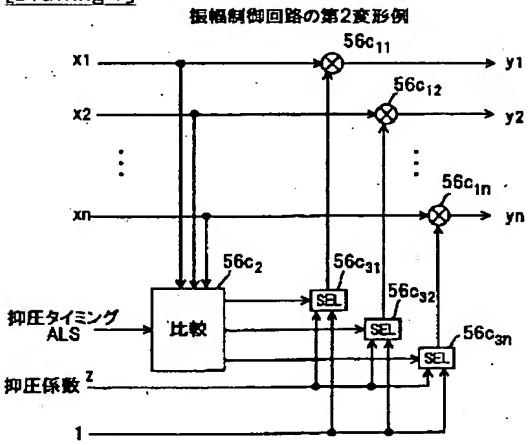
[Translation done.]

DRAWINGS

[Drawing 6]

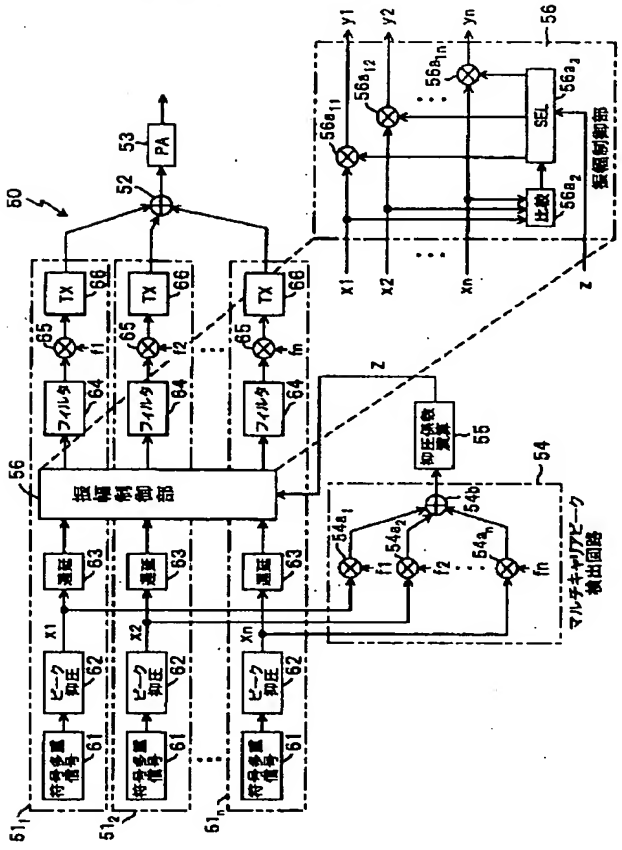


[Drawing 7]



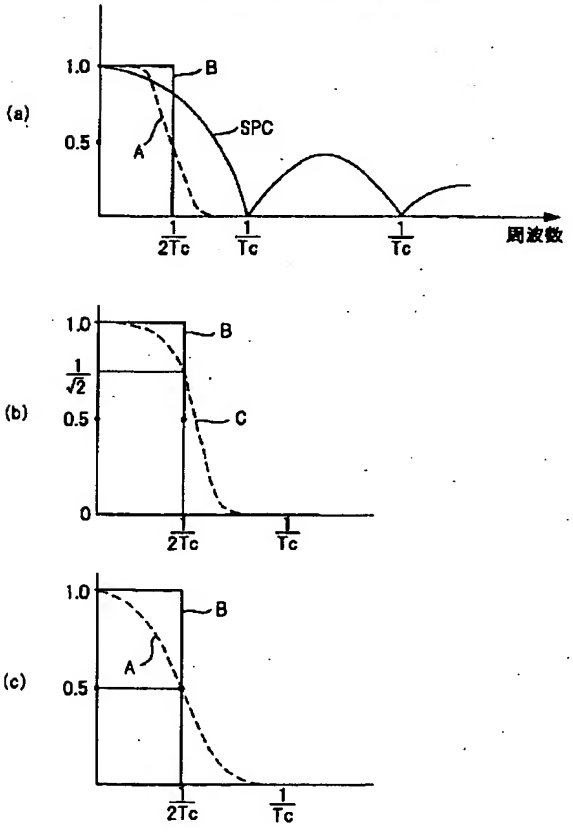
[Drawing 1]

第1実施例の符号多重信号送信装置の構成



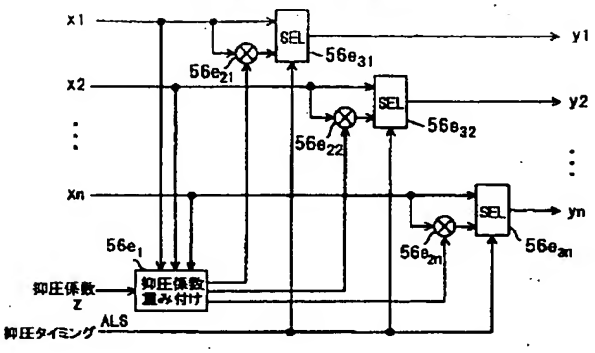
[Drawing 2]

チップ整形フィルタの特性説明図



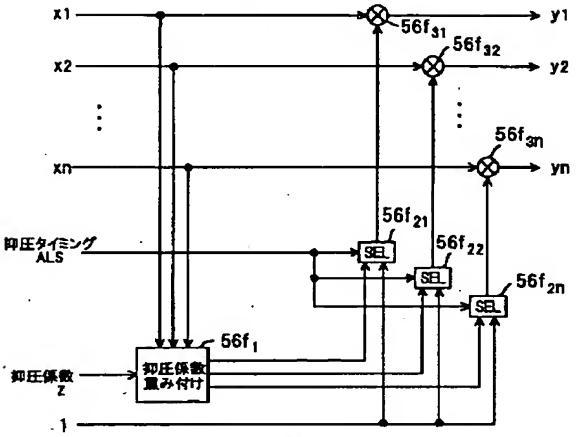
[Drawing 9]

振幅制御回路の第1変形例



[Drawing 10]

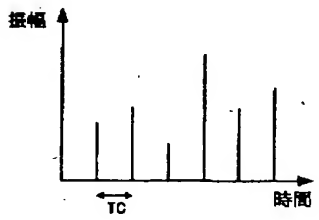
振幅制御回路の第2変形例



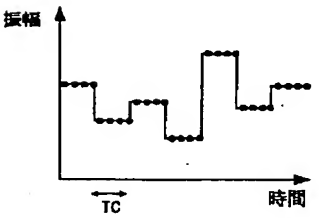
[Drawing 3]

符号多重信号説明図

(A)

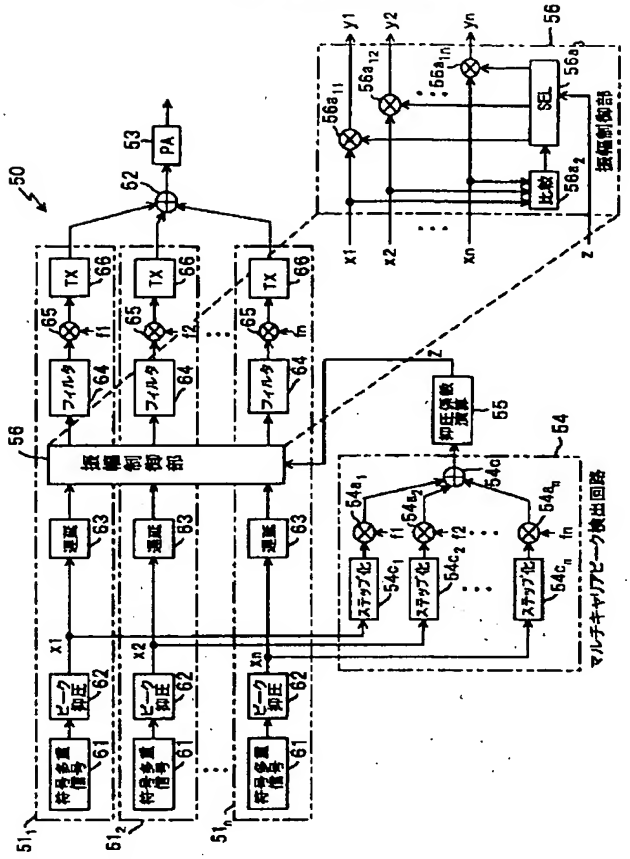


(B)



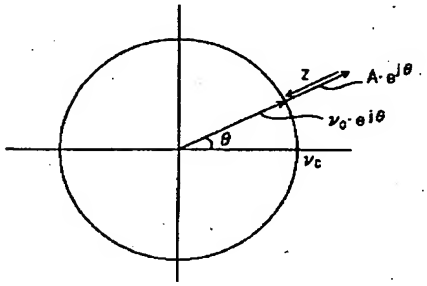
[Drawing 4]

第1実施例の第1変形例



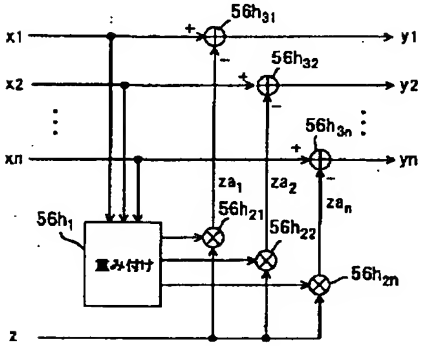
[Drawing 12]

振幅制限部の動作説明図

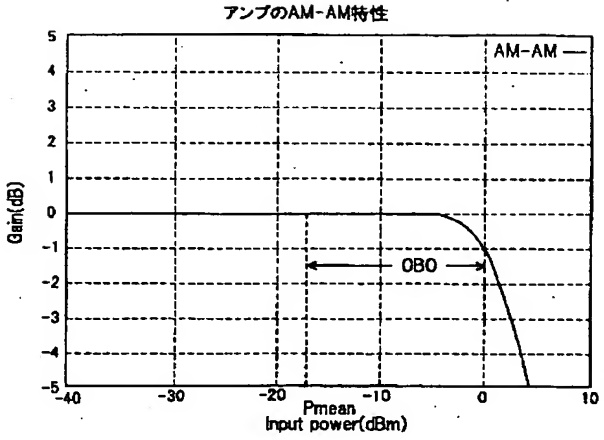


[Drawing 13]

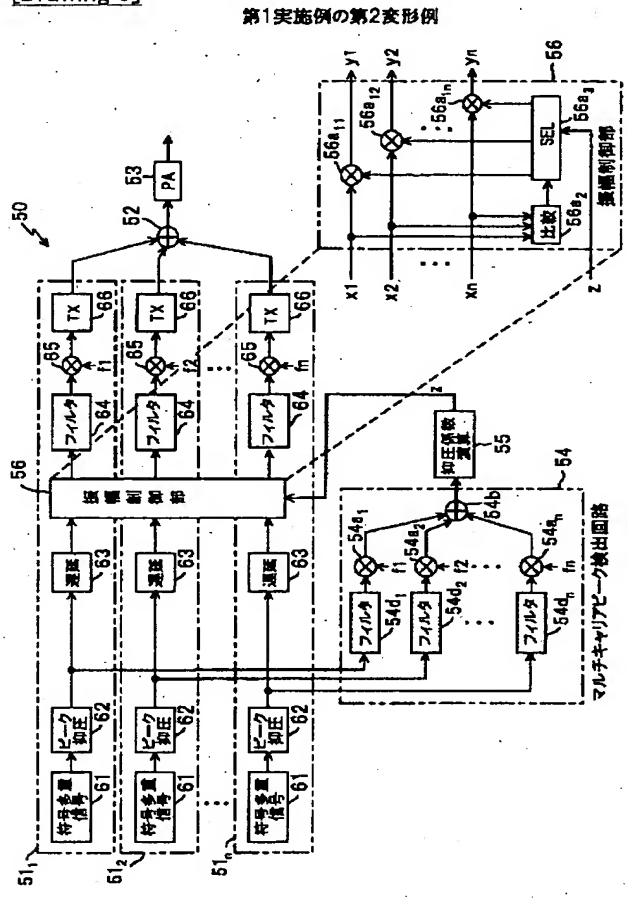
振幅制御回路の変形例



[Drawing 16]

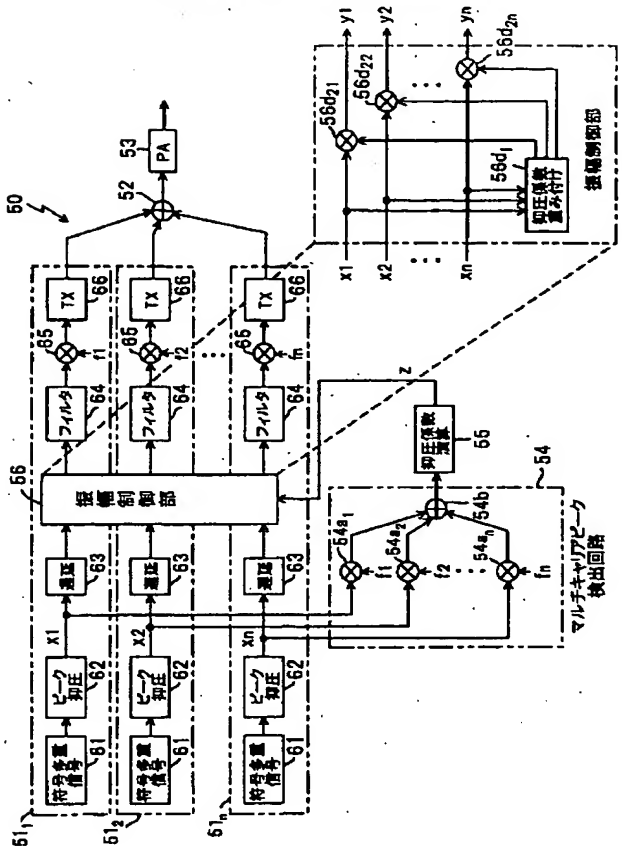


[Drawing 5]

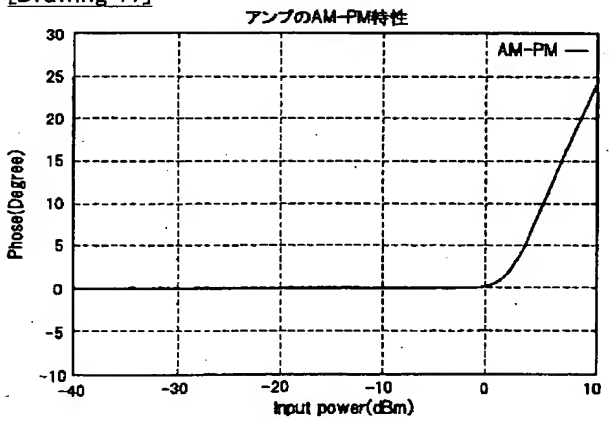


[Drawing 8]

第2実施例の符号多重信号送信装置の構成

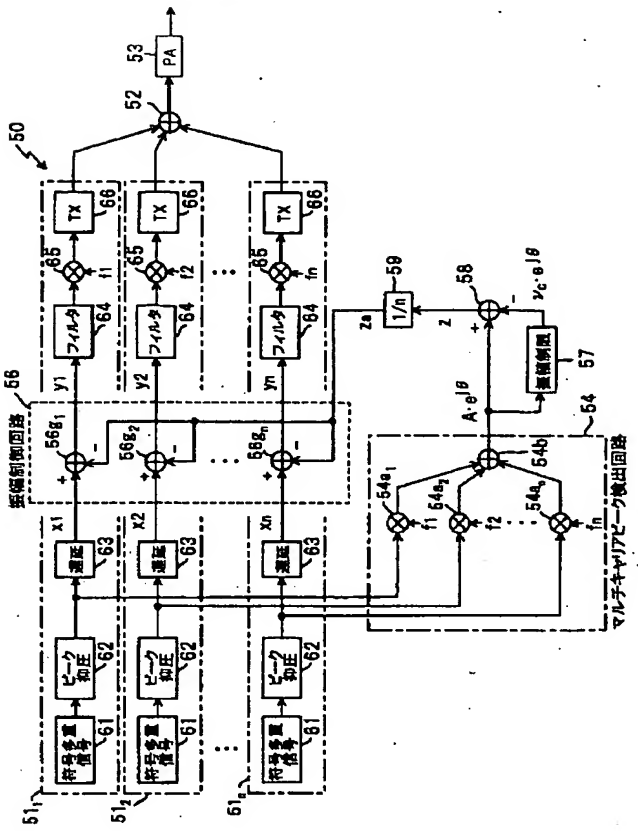


[Drawing 17]



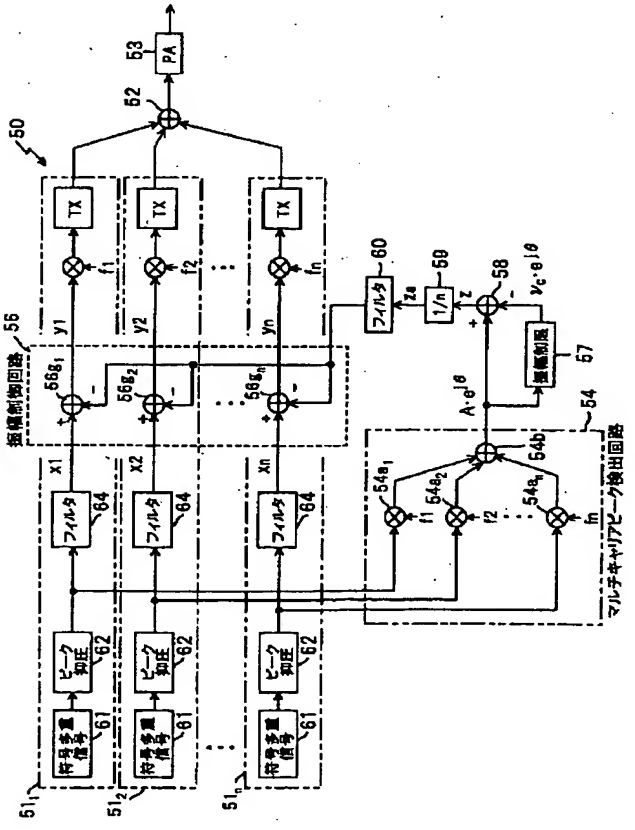
[Drawing 11]

第3実施例の符号多重信号送信装置の構成



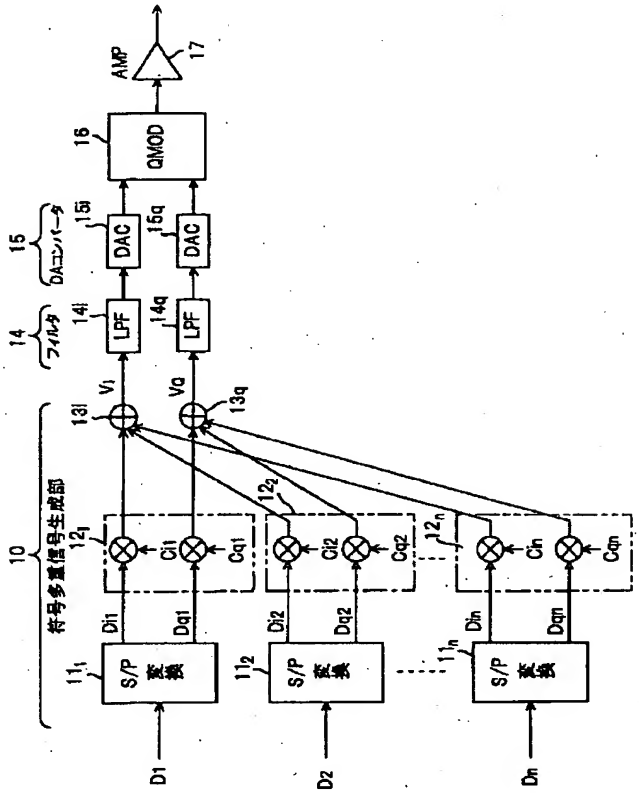
[Drawing 14]

第3実施例の変形例



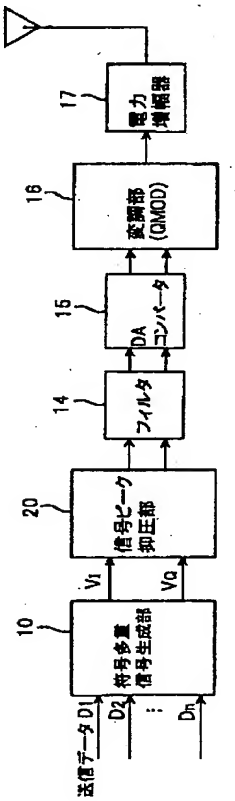
[Drawing 15]

従来のCDMA送信機の構成



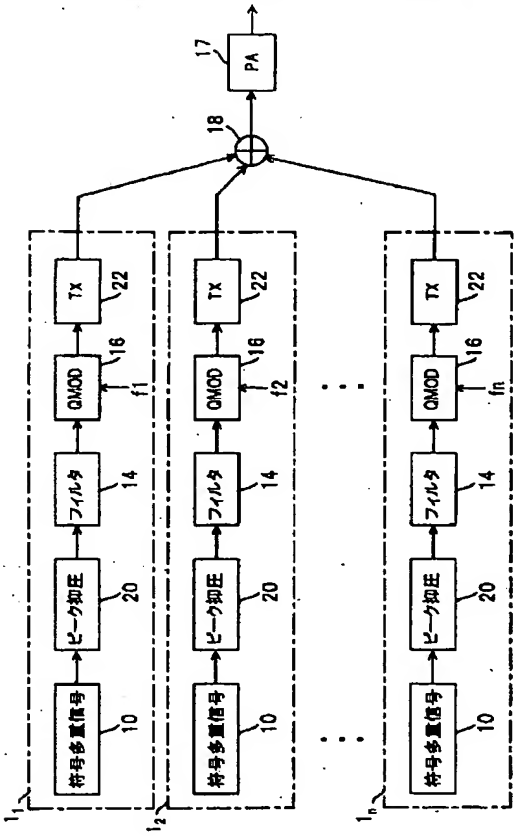
[Drawing 18]

ピーク抑圧部を備えた従来の符号多重信号送信装置



[Drawing 19]

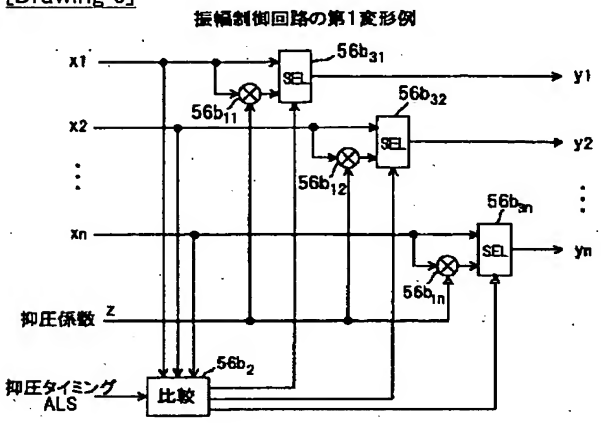
従来の複数キャリアの符号多重信号送信装置の構成



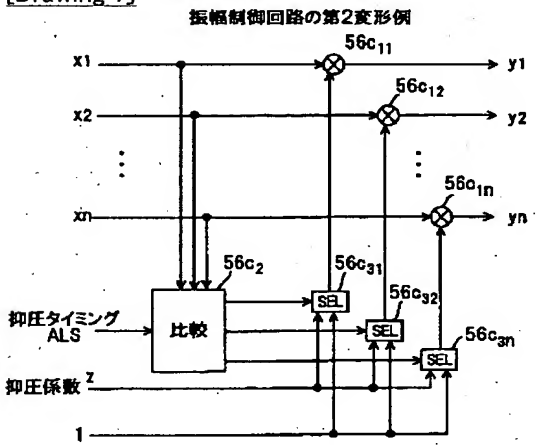
[Translation done.]

DRAWINGS

[Drawing 6]

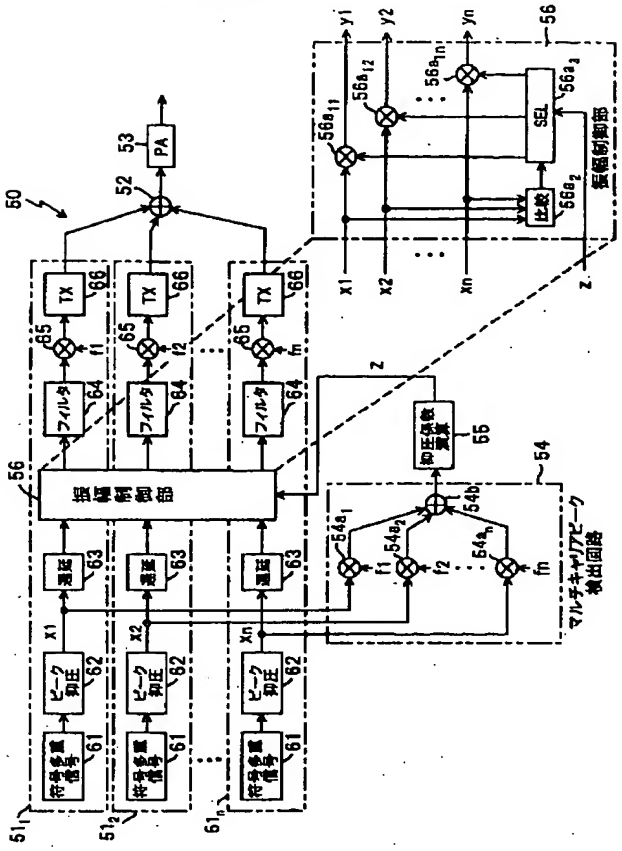


[Drawing 7]



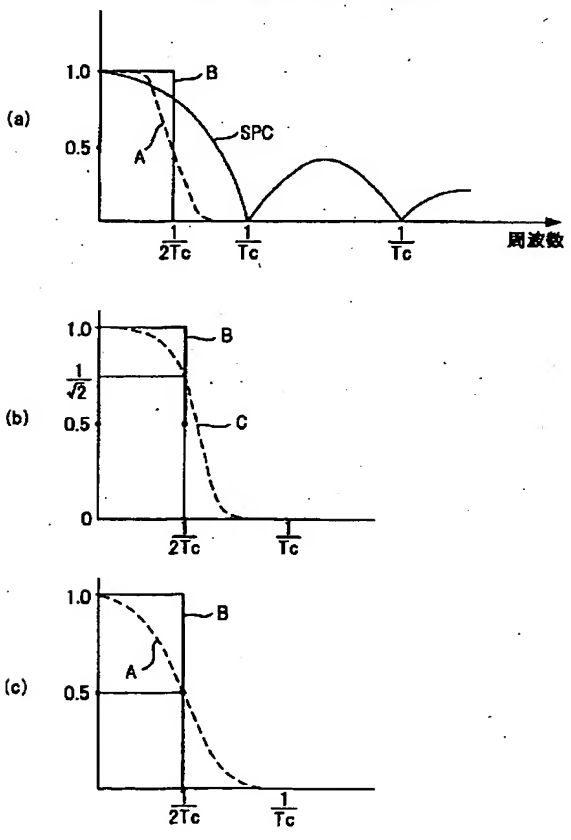
[Drawing 1]

第1実施例の符号多重信号送信装置の構成



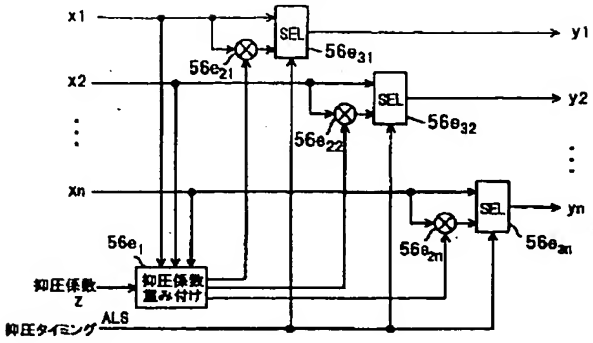
[Drawing 2]

チップ整形フィルタの特性説明図



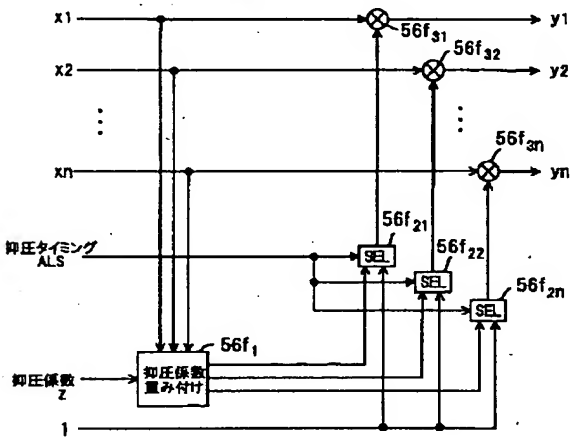
[Drawing 9]

振幅制御回路の第1変形例



[Drawing 10]

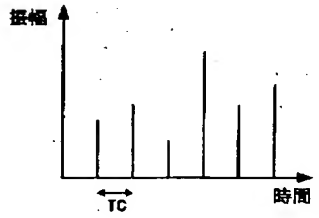
振幅制御回路の第2変形例



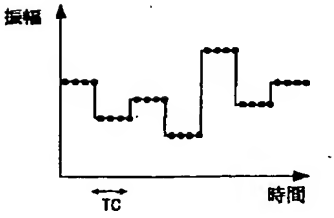
[Drawing 3]

符号多重信号説明図

(A)

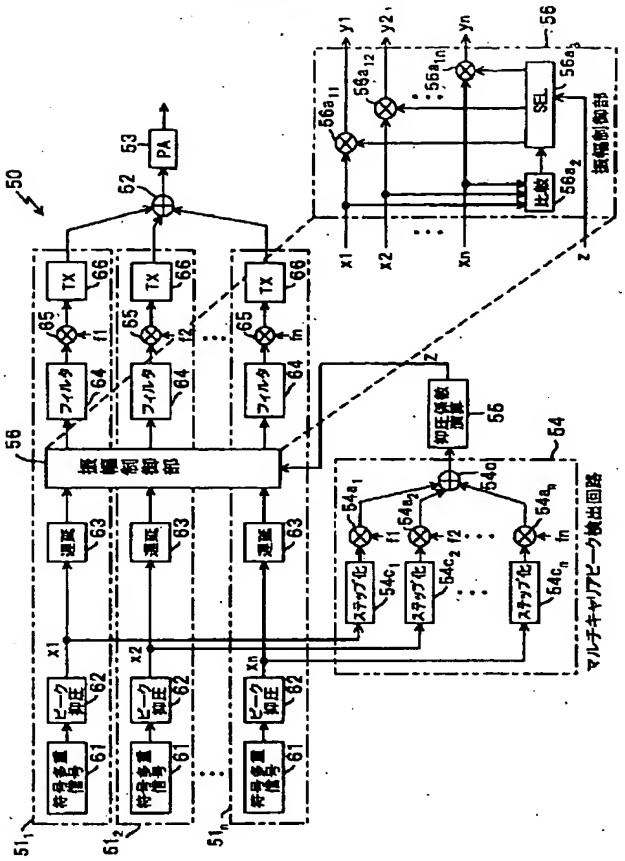


(B)



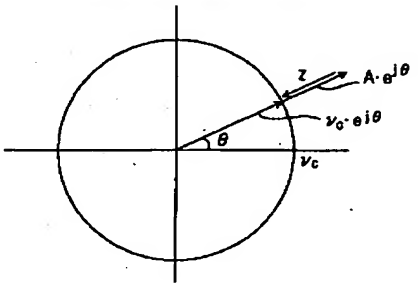
[Drawing 4]

第1実施例の第1変形例



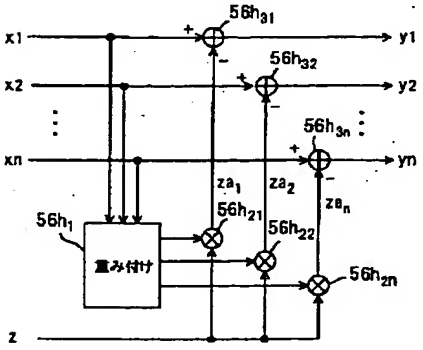
[Drawing 12]

振幅制限部の動作説明図

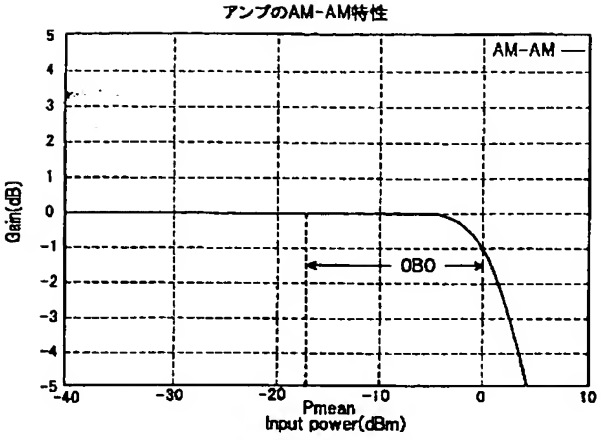


[Drawing 13]

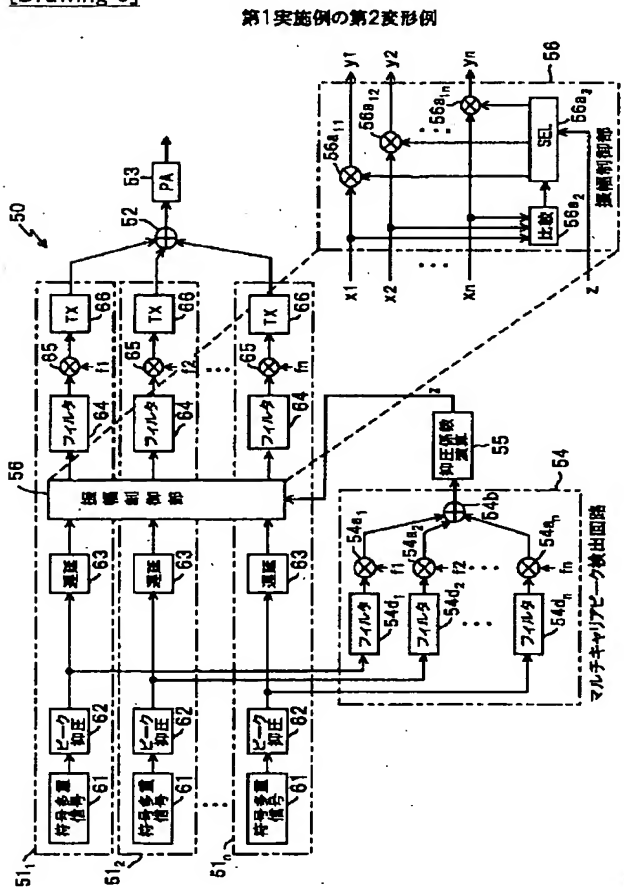
振幅制御回路の変形例



[Drawing 16]

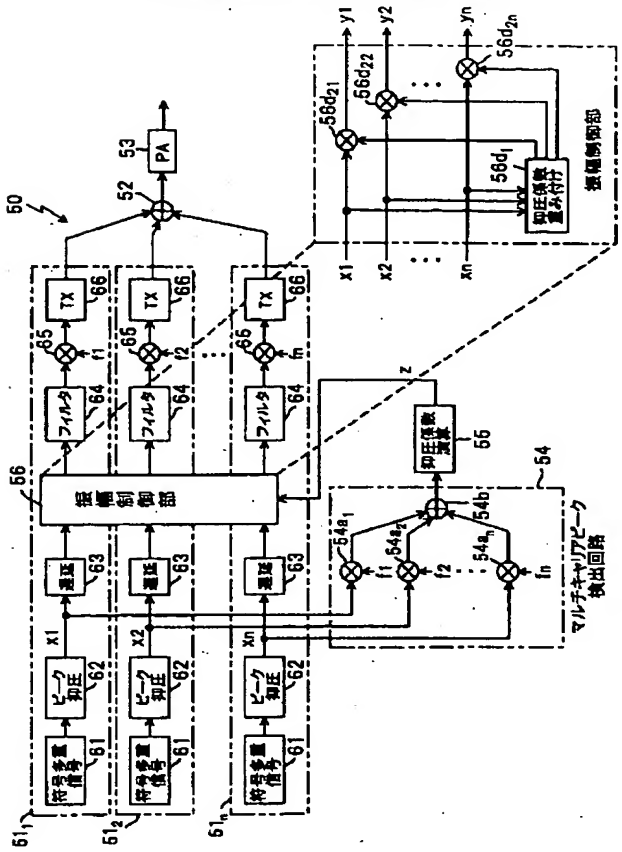


[Drawing 5]

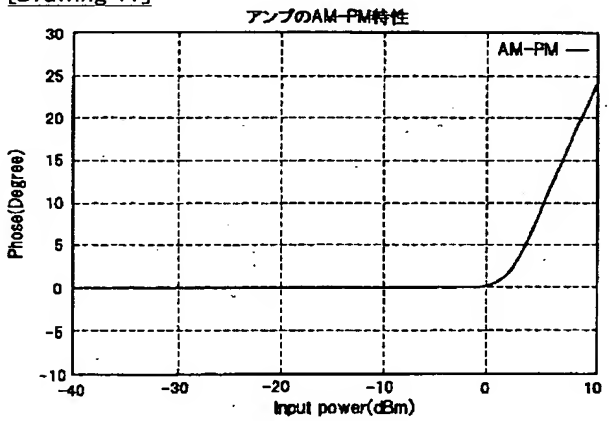


[Drawing 8]

第2実施例の符号多重信号送信装置の構成

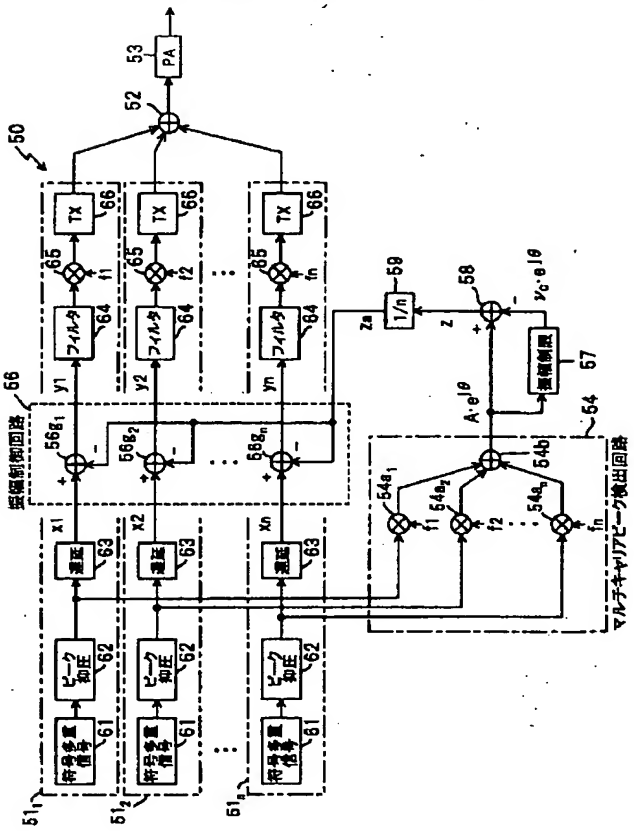


[Drawing 17]



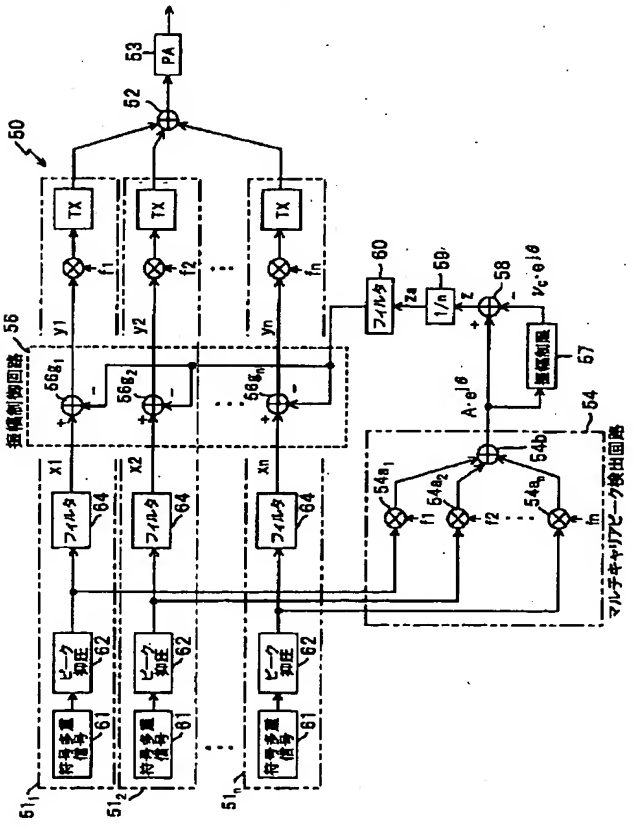
[Drawing 11]

第3実施例の符号多重信号送信装置の構成



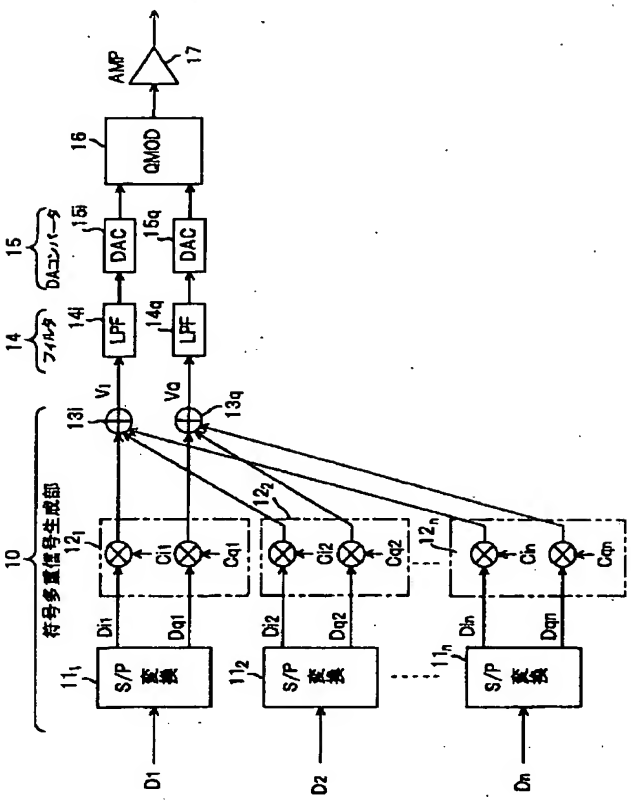
[Drawing 14]

第3実施例の変形例



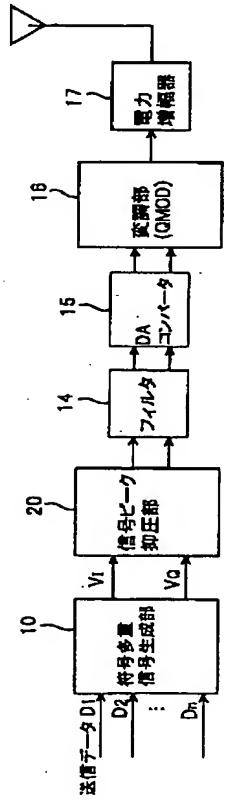
[Drawing 15]

従来のCDMA送信機の構成



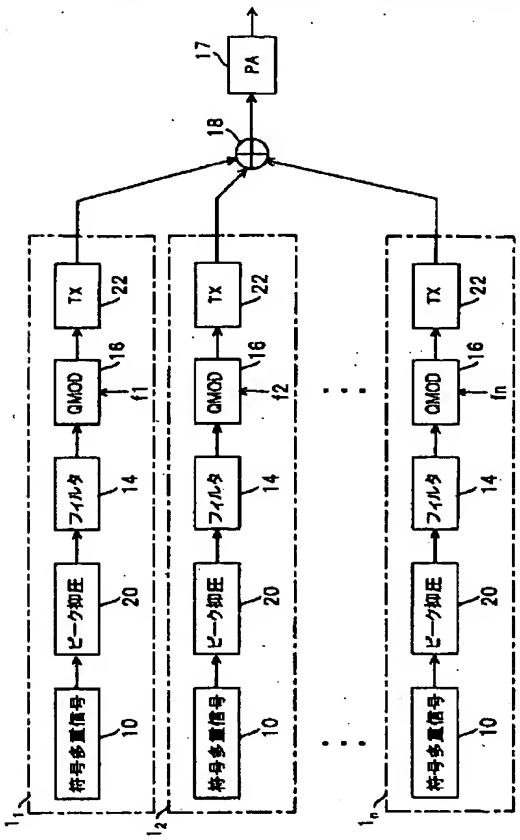
[Drawing 18]

ピーク抑圧部を備えた従来の符号多重信号送信装置



[Drawing 19]

従来の複数キャリアの符号多重信号送信装置の構成



[Translation done.]

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13/00		13/00	Ａ

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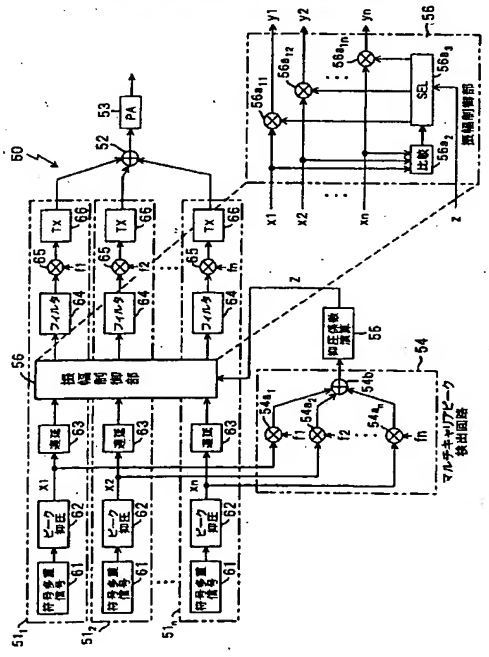
(54)【発明の名称】　符号多重信号送信装置

(57)【要約】
【課題】　キャリア多重信号のピークを抑圧して電力増幅器の効率を改善すると共に、個々の符号多重信号の信号劣化を防止する。
【解決手段】　主信号系と並列にキャリア多重信号のピークを検出する検出部(54)を設け、振幅制御部(56)はキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、主信号系のキャリア多重前の符号多重信号の振幅を抑圧してキャリア多重信号のピークを抑圧する。振幅制御部は、(1) 符号多重信号のうち振幅が最大、あるいは振幅が大きな複数個の信号を選択し、(2) キャリア多重信号の振幅が設定値を越えたとき、(1)で選択してある符号多重信号に抑圧係数を乗算してキャリア多重信号のピークを抑圧する。

第1実施例の符号多重信号送信装置の構成



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【特許請求の範囲】
【請求項１】　符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置において、
複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、
前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、
前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部、
を備え、前記振幅制御部は、
第２のキャリア多重信号のピーク値に与える影響の大きい符号多重信号を選択する選択部、
第２のキャリア多重信号の振幅が設定値を越えたとき、前記選択された符号多重信号に抑圧係数を乗算して第１のキャリア多重信号のピークを抑圧する信号抑圧部、
を備えたことを特徴とする符号多重信号送信装置。
【請求項２】　符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置において、
複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、
前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、
前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部、
を備え、前記振幅制御部は、
第２のキャリア多重信号の振幅が設定値を越えたとき、前記符号多重信号の振幅を抑圧する抑圧係数を決定する抑圧係数決定部、
各符号多重信号の振幅に応じて抑圧係数の重み付けを行う重み付け部、
前記第２のキャリア多重信号の振幅が設定値を越えたとき、前記各符号多重信号に前記重み付けされた抑圧係数を乗算して第１のキャリア多重信号のピークを抑圧する信号抑圧部、
を備えたことを特徴とする符号多重信号送信装置。
【請求項３】　符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置において、
複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、
前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、
前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部、
を備え、前記振幅制御部は、
第２のキャリア多重信号の振幅値が設定値を越えたとき、該キャリア多重信号の振幅と設定値との差分を演算する演算部、
該差分を等分し、あるいは、符号多重信号の振幅に応じて重み付けして配分して振幅抑圧信号を生成する手段、
前記第２のキャリア多重信号の振幅が設定値を越えたとき、前記各符号多重信号より前記振幅抑圧信号を減算してキャリア多重信号のピークを抑圧する信号抑圧部、
を備えたことを特徴とする符号多重信号送信装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は符号多重信号送信装置に係わり、特に、複数の符号多重信号をキャリア多重して送信する符号多重信号送信装置に関する。
【０００２】
【従来の技術】次世代のデジタル移動通信方式として、符号分割多元接続（ＣＤＭＡ：CodeDivision Multiple Access）方式を用いた無線アクセス方式が検討されている。ＣＤＭＡ方式はスペクトラム拡散通信方式を用いた多元接続方法であり、複数のチャネル（ユーザ）の伝送情報を符号によって多重し、無線回線などの伝送路を通じて伝送する。
【０００３】図１５はｎチャネルの送信データを符号多重して伝送するＣＤＭＡ送信機の従来の構成図である。図中、１１$_1$～１１ｎはそれぞれ第１～第ｎチャネルの直列データＤ$_1$～Ｄｎを１ビットづつ交互に振り分けてＩ成分（In-Phase compornent)データＤij(j=1,2,･･･n)とＱ成分(Quadrature compornent)データＤqj(j=1,2,･･･n)の２系列に変換する直列／並列変換部(Ｓ／Ｐ変換部)、１２$_1$～１２ｎは各２系列のデータＤij，Ｄqjに拡散符号系列Ｃij，Ｃqjを乗算する拡散回路、１３ｉは各拡散回路１２$_1$～１２ｎから出力されるＩ成分の拡散変調信号を合成してＩ成分の符号多重信号V_Iを出力する合成部、１３ｑは各拡散回路１２$_1$～１２ｎから出力されるＱ成分の拡散変調信号V_Qを合成してＱ成分の符号多重信号を出力する合成部であり、以上により符号多重信号生成部１０を構成している。
【０００４】フィルタ１４において、１４ｉ，１４ｑは符号多重信号のＩ，Ｑ成分の帯域を制限するチップ整形フィルタであり、ＤＡコンバータ１５において、１５ｉ，１５ｑは各フィルタ１４ｉ，１４ｑの出力をＤＡ変換するＤＡコンバータである。１６はＩ，Ｑ成分の符号多重信号V_I，V_Qに直交変調を施して出力する直交変調器、１７は直交変調器出力を増幅して図示しないアンテ

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ナに入力する電力増幅器である。直交変調器１６はＤＡコンバータ１５ｉの出力信号にキャリア信号cosωtを乗算し、ＤＡコンバータ１５ｑの出力信号に－sinωtを乗算し、各乗算結果を合成して出力する。

【０００５】ＣＤＭＡ方式において、符号多重信号の振幅（図１５の合成部１３ｉ，１３ｑの出力）は、多重する符号数（チャネル数あるいはユーザ数）の電圧和となるため、その最大電力Ｐmaxは多重数の二乗に比例する。すなわち、各拡散回路の出力は＋１，－１のいずれかであり、ｎチャネルのすべての拡散回路から＋１が出力されている時の符号多重信号の最大振幅はｎとなり、最大電力はn^2に比例する。一方、平均電力Ｐmeanは多重数ｎに比例する。以上より、多重数ｎが多い場合における符号多重信号のピークファクタ（＝Ｐmax／Ｐmean）は大きくなる。

【０００６】一般に、無線通信において、通信に使用する周波数帯域は制限される。このため、電力増幅器１７（図１５）の非線形歪みによる周波数スペクトラムの拡大（不要輻射電力の増大）を低く抑える必要がある。すなわち、周波数スペクトラムの拡大は隣接妨害等の原因になるため、その拡大を低く抑える必要がある。かかる要求から符号多重信号を電力増幅器で増幅する場合、線形領域で動作させる必要があり、大きな出力バックオフを取らなければならない。しかし、出力バックオフを大きくすると電力増幅器の電力効率を著しく劣化させる問題が生じる。一方、十分な出力バックオフをとらなければ、電力増幅器の非線形歪みによってスペクトラムの拡大を生じ、システムの周波数利用効率を低下させる問題が生じる。

【０００７】図１６は電力増幅器のＡＭ－ＡＭ特性（入力パワー／ゲイン特性）、図１７は電力増幅器のＡＭ－ＰＭ特性（入力パワー／位相特性）の例である。電力増幅器は、入力パワーが小さいうちはゲイン特性、位相特性がフラットでありその入出力特性は線形であり、位相回転もしない。しかし、入力パワーがあるレベル以上になるとゲインが小さくなりはじめると共に位相遅れが発生し、各特性は非線形になる。ゲインが１dB下がった出力パワーレベルを１dBコンプレッションレベルといい、該レベルと平均出力電力との差が出力バックオフOBOである。かかる非線形増幅器では、入力信号の平均電力レベルが線形部分に存在していても、出力バックオフOBOとピークファクタの兼ね合いにより、最大電力レベルあるいはそれに近いレベルの信号は１dBコンプレッションレベルを越えてしまい、歪が発生し、周波数スペクトラムが拡大する。前述のようにＣＤＭＡ送信機ではピークファクタが非常に大きいため、この問題は深刻である。

【０００８】そこで、最大電力レベルの入力信号到来時に１dBコンプレッションレベルを越えないように入力信号の平均電力レベルを下げて出力バックオフOBOを大きくすると、歪が生じず、周波数スペクトラムの拡大もないが。しかし、平均電力レベルを下げるということは電力増幅器の電力効率を低下させる。以上より、従来は、入力信号の平均電力レベルを下げて（出力バックオフOBOが大きい）電力増幅器における歪や周波数スペクトラムの拡大を防止すると、電力増幅器の電力効率が低下し、逆に、入力信号の電力平均レベルを上げて（出力バックオフOBOが小さい）電力増幅器の効率を上げると電力増幅器における歪が発生し、周波数スペクトラムが拡大する問題があった。また、図１５に示すように符号多重信号をディジタル信号処理によって生成する構成ではＤＡコンバータ１５ｉ，１５ｑが必要である。かかるＤＡコンバータの量子化ビット数は有限であり、そのフルスケールは符号多重信号の最大値を出力できるように設定される。しかし、ＣＤＭＡ送信機では符号多重信号のピークファクタが非常に大きいため、発生頻度の高い平均電力周辺の信号に対する有効ビット数が減少し、量子化ノイズが大きくなる。この量子化による劣化は、例えばスペクトラム特性のノイズフロアなどを劣化させ、隣接妨害の原因になる。

【０００９】以上より、図１８に示すように合成信号のピーク値を抑圧する信号ピーク抑圧部２０を設けた符号多重信号送信装置が提案されている（特開平10-178414号）。尚、図１８において、図１５と同一部分には同一符号を付している。信号ピーク抑圧部２０は、符号多重信号のエンベロープを検出し、エンベロープ値と設定レベルを比較し、エンベロープ値が設定レベル以上の場合には、該エンベロープ値を設定レベルにする減衰度を求め、該減衰度を符号多重信号V_I，V_Qに乗算することにより、ピーク値を抑圧する。以上のように、符号多重信号のピーク値を抑圧することによりピークファクタを小さくでき、この結果、出力バックオフOBOが小さくても出力信号の最大電力レベルが１dBコンプレッションレベルを越えないようにできる。すなわち、電力増幅器の効率を改善でき、しかも、歪の発生、周波数スペクトラムの拡大を防止できる。また、フィルタ１４の最大出力振幅をＤＡコンバータ１５のフルスケールとする。このようにしても、ピークファクタが小さいため、発生頻度の高い平均電力周辺の信号に対する有効ビット数を多くでき出力スペクトラムのノイズフロアを低減でき、また、ＤＡコンバータの所要ビット数を削減できる。

【００１０】

【発明が解決しようとする課題】複数のチャネルを扱う基地局装置は、前述のように符号多重された信号を生成するが、多重するチャネル数の増大により、更に、複数の符号多重信号をキャリア多重して送信する機能が要求される。図１９はかかる複数の符号多重信号をキャリア多重して送信する符号多重信号送信装置の構成図であり、符号多重信号をｎキャリア分多重し、電力増幅して送信する構成を有している。1_1～1_nはそれぞれ１キャリア分の符号多重信号送信部であり、図１８と略同一の

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構成を有しており、同一部分には同一符号を付している。尚、符号多重信号送信部１$_1$～１ｎにおいて、ＤＡコンバータの図示を省略し、代わって各直交変調信号を高周波信号に周波数変換する送信回路（ＴＸ）２２が付加されている。各符号多重信号送信部１$_1$～１ｎの直交変調部１６はΔｆ間隔の周波数ｆ$_1$～ｆｎのキャリア信号により直交変調する。合成部１８は各符号多重信号送信部１$_1$～１ｎから出力する送信信号をキャリア多重して電力増幅器１７に入力し、電力増幅器はキャリア多重された送信信号を増幅してアンテナより放射する。

【００１１】図１９の符号多重信号送信装置は、それぞれの符号多重信号送信部１$_1$～１ｎにおいて各符号多重信号のピークを抑圧できるが、キャリア多重で生じるピークの抑圧を行っていない。このため、最終的に電力増幅器１７で増幅するキャリア多重信号のピークファクタが大きくなり、電力増幅器の効率を低下する問題がある。そこで、キャリア多重信号に対して直接ピーク抑圧を行うことが考えられるが、抑圧による信号のひずみがスペクトル特性を劣化させる。又、キャリア多重信号の振幅を検出してからピーク抑圧を行う方式では、既にピーク抑圧前の信号が電力増幅器に入力しており、すなわち、ピーク抑圧前の信号が電力増幅器に入力してからピーク抑圧するためピーク抑圧制御が遅くなる。

【００１２】以上から本発明の目的は、キャリア多重信号のスペクトル特性を劣化させることなく、キャリア多重信号のピークを抑圧でき、しかも、ピーク抑圧前の信号が電力増幅器に入力しないようにすることである。本発明の別の目的は、個々の符号多重信号の振幅を制御してキャリア多重信号のピークを抑圧するが、かかる場合であっても、小振幅の符号多重信号の信号劣化（変調精度の劣化）を防止することである。本発明の別の目的は、ピーク抑圧信号の帯域制限フィルタを主信号系の帯域制御フィルタと独立に制御することにより、大きなピーク抑圧を可能にすることである。

【００１３】

【課題を解決するための手段】本発明は、符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置であり、(1) 複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、(2) 前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、(3) 前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部を備えている。本発明の第１の振幅制御部は、キャリア多重信号のピーク値に大きな影響を与える符号多重信号、たとえば振幅の大きな符号多重信号を選択し、第２のキャリア多重信号の振幅が設定値を越えたとき、該選択された符号多重信号に抑圧係数を乗算して第１のキャリア多重信号のピークを抑圧する。

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【００１４】本発明の第２の振幅制御部は、第２のキャリア多重信号の振幅が設定値を越えたとき、各符号多重信号の振幅を抑圧する抑圧係数を決定し、各符号多重信号の振幅に応じて抑圧係数の重み付けを行い、第２のキャリア多重信号の振幅が設定値を越えたとき、各符号多重信号に重み付けされた抑圧係数を乗算して第１のキャリア多重信号のピークを抑圧する。第３の振幅制御部は、第２のキャリア多重信号の振幅値が設定値を越えたとき、該キャリア多重信号の振幅値と設定値との差分を演算し、該差分を各符号多重信号に等分し、あるいは、符号多重信号の振幅に応じて重み付けして配分して振幅抑圧信号を生成し、各符号多重信号より振幅抑圧信号を減算してキャリア多重信号のピークを抑圧する。

【００１５】以上のように、本発明によれば、キャリア多重信号のピーク抑圧において、主信号系のキャリア多重部とは別のピーク検出用のキャリア多重回路を設け、これを用いてキャリア多重信号のピークを検出してキャリア多重前の信号振幅を制御するようにしたから、キャリア多重信号のスペクトル特性を劣化させることなく、キャリア多重信号のピークを抑圧でき、しかも、本発明によれば、ピーク検出時間を短縮できるため、短時間の遅延部を設けるなどしてピーク抑圧前の信号が電力増幅器に入力しないようにできる。又、本発明によれば、個々の符号多重信号の振幅を制御してキャリア多重信号のピークを抑圧する場合、ピークに影響を与える振幅の大きな符号多重信号のみ振幅抑圧し、あるいは、ピークに影響を与える振幅の大きさに基づいて抑圧量を重み付けするため、キャリア多重信号のピーク抑圧制御により小振幅の符号多重信号が劣化（変調精度の劣化）することはない。

【００１６】又、抑圧が必要な時刻の符号多重信号に対して抑圧係数を乗算してキャリア多重信号のピーク値を抑圧するように構成することにより、ピーク抑圧を簡単に行うことができる。又、ピーク抑圧信号を符号多重信号より減算する構成では、ピーク抑圧信号の帯域制限フィルタを主信号系の帯域制御フィルタと独立に制御し、かつ、ピーク抑圧信号の帯域制限フィルタを適当な特性に設定することにより、若干のスペクトルの劣化を許容することで、より大きなピーク抑圧が可能になる。

【００１７】

【発明の実施の形態】（Ａ）第１実施例

図１は複数の符号多重信号をキャリア多重して送信する本発明の第１実施例である符号多重信号送信装置の構成図であり、符号多重信号をｎキャリア分多重し、電力増幅して送信する構成を有している。５１$_1$～５１ｎはそれぞれ１キャリア分の符号多重信号送信部、５２は各符号多重信号送信部から出力するｎキャリア分の高周波信号を加算して出力する加算部、５３はｎキャリア分の多重

信号を増幅してアンテナ（図示せず）に入力する電力増幅器である。符号多重信号送信部５１$_1$～５１$_n$と加算部５２は主信号系の第１のキャリア多重回路５０を構成する。５４はピーク検出のために各符号多重信号をキャリア多重するピーク検出系のマルチキャリアピーク検出回路（第２のキャリア多重回路）、５５は２のマルチキャリアピーク検出回路５４から出力するキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、抑圧係数ｚを出力する抑圧係数演算部、５６は抑圧係数ｚ及び各符号多重信号$x_1(t)$～$x_n(t)$の振幅値に基づいて各符号多重信号の振幅を抑圧する振幅制御部である。

【００１８】符号多重信号送信部５１$_1$～５１$_n$は同一の構成を備えており、符号多重信号生成部６１は所定の符号でそれぞれ拡散された複数の拡散データを合成して符号多重信号を出力する。ピーク抑圧部６２は、符号多重信号のエンベロープを検出し、エンベロープ値と設定レベルを比較し、エンベロープ値が設定レベル以上の場合には、該エンベロープ値を設定レベルにする減衰度を求め、該減衰度を符号多重信号に乗算することにより、ピーク値を抑圧する。遅延部６３はキャリア多重信号のピークを減衰する抑圧係数が求まるまでの時間、ピーク抑圧部６２の出力信号を遅延する。

【００１９】フィルタ６４は振幅制御部５６から出力する振幅制御された符号多重信号の帯域を制限するチップ整形フィルタである。符号多重信号のスペクトラム分布は図２(a)の実線ＳＰＣで示すように sinc曲線形状を有し、Ｉ／Ｔｃ(Ｔｃはチップ周期)以上の帯域は不要である。そこで、点線Ａで示す周波数特性を有するフィルタにより帯域制限する。Ｂは理想フィルタの周波数特性である。ところで、無線においては、送信機、受信機それぞれに設けたフィルタの合成特性が図２（ａ）の点線Ａになるようにする必要がある。そこで、チップ整形フィルタ６４にはそれぞれ、図２（ｂ）に示すルートロールオフ特性Ｃを設定し、送受信器の合成フィルタ特性が図２（ａ）あるいは図２（ｃ）に示す特性Ａになるように配分する方法が一般的である。

【００２０】周波数シフト部６５は符号多重信号にキャリア周波数f_1～f_nを乗算して周波数シフトする。具体的には、図１５で説明したように周波数シフト部６５は直交変調部(QMOD)で構成する。直交変調部は符号多重信号生成部６１から出力する符号多重信号のＩ成分にキャリア信号$\cos\omega_i t$を乗算し、Ｑ成分に$-\sin\omega_i t$を乗算し、各乗算結果を合成して出力する。送信回路６６は直交変調部６５の出力を高周波信号に周波数変換して加算器５２に入力する。尚、図では各直交変調器６５の出力信号を個々に高周波信号に周波数変換しているが、各直交変調部の出力信号を合成し、１つの送信回路(TX)で合成変調信号を周波数変換して加算部５２に入力するように構成することもできる。

【００２１】マルチキャリアピーク検出回路５４において、周波数シフト部５４a_1～５４a_nは符号多重信号$x_1(t)$，$x_2(t)$，．．．$x_n(t)$にキャリア周波数f_1～f_nを乗算して周波数シフトし、合成部５４ｂは周波数シフトされた各符号多重信号を周波数多重してキャリア多重信号を出力する。符号多重信号$x_1(t)$，$x_2(t)$，．．．$x_n(t)$がディジタルであれば、周波数シフト部５４a_1～５４a_nは符号多重信号$x_1(t)$，$x_2(t)$，．．．$x_n(t)$に$\exp(j\omega_1 t)$，$\exp(j\omega_2 t)$，．．．$\exp(j\omega_n t)$（$\omega_n=2\pi f_n$）を乗算して周波数シフトを施す。各キャリアの符号多重信号はチップ時間Ｔｃのサンプル列として与えられるから、マルチキャリアピーク検出回路５４は、これを図３（Ａ）に示すようなインパルス列として周波数多重の演算を行う。

【００２２】抑圧係数演算部５５は、キャリア多重信号が設定値v_c以下であれば抑圧係数ｚ＝１を出力し、設定値以上であれば、所定の抑圧係数ｚ（＜１）を出力する。具体的には、(1)，(2)式により抑圧係数を求める。式中、符号多重信号を$x_i(t)$、振幅抑圧後の符号多重信号を$y_i(t)$とする。ここで、ｘ，ｙは複素数（等価ベースバンド表現）、ｇは実数、ω_iはキャリアの角周波数である。

$$y_i(t) = \{g(|z(t)|)/|z(t)|\} \cdot x_i(t) \qquad (1)$$

$$|z(t)| = \Sigma_i x_i(t)\exp(j\omega_i t) \quad (i=1\sim N) \qquad (2)$$

ここで、$g(|z(t)|)$は抑圧を制御する関数であり、閾値レベルv_cでエンベロープにリミッタを掛けるような

$$g(|z(t)|) = |z| \qquad |z| \leqq v_c \text{の場合} \qquad (3a)$$

$$g(|z(t)|) = v_c \qquad |z| > v_c \text{の場合} \qquad (3b)$$

ハードクリップの場合、(3a)、(3b)式で与えられる。

尚、抑圧係数ｚは次式

$z = g(|z(t)|)/|z(t)|$

で与えられる。

【００２３】振幅制御部５６において、乗算部５６a_{11}～５６a_{1n}は各符号多重信号$x_i(t)$に抑圧係数を乗算する。比較部５６a_2は各符号多重信号の振幅を比較し、キャリア多重信号のピーク値に与える影響の大きい信号、たとえば、振幅が最大の符号多重信号、あるいは、振幅の大きな符号多重信号を複数個決定する。選択部５６a_3は、抑圧係数ｚ＝１であれば、各乗算部５６a_{11}～５６a_{1n}に抑圧係数ｚ＝１を入力する。この結果、乗算部出力は入力と同じであり、いずれの符号多重信号をも抑圧しない。しかし、選択部５６a_3は抑圧係数ｚ＜１であれば、該抑圧係数ｚを振幅が最大、あるいは、振幅が大きな複数の符号多重信号に応じた乗算部に入力し、他の乗算部には１を入力する。この結果、キャリア

多重信号のピーク値に与える影響が大きい符号多重信号のみ、信号振幅を抑圧されてマルチキャリアのピークが抑圧される。この場合、キャリア多重信号のピーク値に与える影響の小さな符号多重信号を抑圧しないから、該小振幅信号の信号劣化（変調精度の劣化）を防止することができる効果がある。

【００２４】・第１実施例の変形例

図４は第１実施例の第１変形例であり、図１の第１実施例と同一部分には同一符号を付している。異なる点は、マルチキャリアピーク検出部５４内部にステップ化部５４c_1～５４c_nを設け、各キャリアの符号多重信号を図３（Ｂ）に示すようにオーバサンプルしてステップ関数に変換し、しかる後、周波数シフト、周波数多重演算を行う点である。

【００２５】図５は第１実施例の第２変形例であり、図１の第１実施例と同一部分には同一符号を付している。異なる点は、マルチキャリアピーク検出部５４内部にフィルタ５４d_1～５４d_nを設け、各キャリアの符号多重信号をオーバサンプルしてフィルタにより波形整形し、しかる後、周波数シフト、周波数多重演算を行う点である。フィルタ５４d_1～５４d_nに送信信号系のフィルタ６４と同じ特性（たとえばルートレイズドコサインなど）を用いることにより、正確なキャリア多重信号のピークを検出することができる。しかし、遅延が大きくなる。一方、フィルタ５４d_1～５４d_nに簡易な特性（インパルスレスポンスの収束が早い）を用いることによりステップ関数より正確なキャリア多重信号のピークを検出でき、しかも、遅延を小さくできる。

【００２６】・振幅制御部の変形例

図６、図７は振幅制御部５６の変形例であり、これらの振幅制御部は、抑圧が必要な時刻の符号多重信号に対して抑圧係数を乗算した出力を選択し、抑圧が不要な時刻の信号に対しては抑圧しない元の信号を選択出力する。図６の振幅制御部において、乗算部５６b_{11}～５６b_{1n}は各符号多重信号$x_i(t)$に抑圧係数ｚを乗算する。比較部５６b_2は各符号多重信号$x_i(t)$の振幅を比較し、キャリア多重信号のピーク値に与える影響の大きい信号、たとえば、振幅が最大の符号多重信号、あるいは、振幅の大きな複数の符号多重信号を抑圧すべき信号であると決定する。かかる状態において、比較部５６b_2は、(1) 抑圧タイミングでない時(振幅抑圧不要時)、セレクタ５６b_{31}～５６b_{3n}に対し各符号多重信号$x_i(t)$をそのまま出力するよう指示し、(2) 抑圧タイミング時(振幅抑圧必要時)、抑圧すべき符号多重信号に応じたセレクタに対して乗算器出力を選択するよう指示し、それ以外のセレクタに対して符号多重信号$x_i(t)$をそのまま出力するよう指示する。この結果、セレクタ５６b_{31}～５６b_{3n}は振幅抑圧不要時、各符号多重信号$x_i(t)$を抑圧することなくそのまま出力し、振幅抑圧必要時、振幅が小さな符号多重信号は抑圧することなくそのまま出力し、

振幅が最大の符号多重信号、あるいは、振幅の大きな複数の符号多重信号は、抑圧したものを出力する。

【００２７】抑圧タイミング信号ALSは、抑圧係数演算部５５（図１）より出力される。すなわち、抑圧係数演算部５５はキャリア多重信号の振幅が設定値v_c以下であれば抑圧係数ｚ＝１を出力すると共に抑圧タイミング信号ALSを発生せず、設定値以上であれば、所定の抑圧係数ｚ（＜１）を出力すると共に、抑圧タイミング信号ALSを出力する。

【００２８】図７の振幅制御部において、乗算部５６c_{11}～５６c_{1n}は各符号多重信号$x_i(t)$に抑圧係数ｚあるいは１を乗算する。比較部５６c_2は各符号多重信号$x_i(t)$の振幅を比較し、キャリア多重信号のピーク値に与える影響の大きい信号、たとえば、振幅が最大の符号多重信号、あるいは、振幅の大きな複数の符号多重信号を抑圧すべき信号であると決定する。かかる状態において、比較部５６c_2は、(1) 抑圧タイミングでない時(振幅抑圧不要時)、セレクタ５６c_{31}～５６c_{3n}に対して１を選択するよう指示し、(2) 抑圧タイミング時(振幅抑圧必要時)、抑圧すべき符号多重信号に応じたセレクタに対して抑圧係数ｚを選択するよう指示し、それ以外のセレクタに対して１を選択するよう指示する。この結果、乗算部５６c_{11}～５６c_{1n}は振幅抑圧不要時、各符号多重信号$x_i(t)$を抑圧することなくそのまま出力し、振幅抑圧必要時、振幅が小さな符号多重信号は抑圧することなくそのまま出力し、振幅が最大の符号多重信号、あるいは、振幅の大きな複数の符号多重信号は抑圧係数ｚを乗算して抑圧したものを出力する。

【００２９】（Ｂ）第２実施例

図８は複数の符号多重信号をキャリア多重して送信する本発明の第２実施例の構成図であり、図１の第１実施例と同一部分には同一符号を付している。異なる点は、振幅制御部５６の構成である。振幅制御部５６は、抑圧係数演算部５５で求めたピーク抑圧係数ｚを各キャリア信号の振幅あるいは電力で重み付けし、各キャリアに乗算する構成を備えている。すなわち、抑圧係数重み付け部５６d_1は各符号多重信号$x_i(t)$の振幅を比較し、キャリア多重信号のピーク値に対する影響が大きい信号ほど、すなわち、信号振幅が大きい符号多重信号ほど、抑圧係数ｚが小さくなるような重みを決定する。たとえば、抑圧係数ｚに重みｗを掛けた値ｚ・ｗは１以下であるから、ｗ≦１／ｚとなり、ｚ＝0.8であれば、ｗ≦1.25となる。従って、一例として振幅により重みを３段階に分け、大振幅信号の重みｗを0.8、中振幅信号の重みｗを1.0、小振幅信号の重みを1.20にする。

【００３０】重み付け部５６d_1は、抑圧係数ｚが１であれば、重み付けすることなく１をそのまま乗算部５６d_{21}～５６d_{2n}に入力する。この結果、乗算部出力は入力と同じであり、いずれの符号多重信号をも抑圧しない。しかし、ｚ＜１であれば重み付け部５６d_1は抑圧

係数ｚに重みｗｉを掛けたものを乗算部５６ｄ21～５６ｄ2nに入力する。この結果、キャリア多重信号のピーク値に与える影響が大きい符号多重信号ほど信号振幅が抑圧されてキャリア多重信号のピークが抑圧される。この場合、振幅の小さな符号多重信号をあまり抑圧しないから、該小振幅信号の信号劣化（変調精度の劣化）を防止することができる。

【００３１】・振幅制御回路の変形例

図９、図１０は振幅制御部の変形例であり、これらの振幅制御部は、抑圧が必要な時刻の符号多重信号に対して抑圧係数を乗算したものを選択し、抑圧が不要な時刻の信号に対しては抑圧しない元の信号を選択出力する。図９の振幅制御部において、抑圧係数重み付け部５６ｅ1は各符号多重信号ｘｉ(t)の振幅を比較し、キャリア多重信号のピーク値に対する影響が大きい信号ほど、たとえば、信号振幅が大きい符号多重信号ほど、抑圧係数が小さくなるような重みを決定する。そして、重み付け部５６ｅ1は抑圧係数ｚに重みｗｉを掛けたものを乗算部５６ｅ21～５６ｅ2nに入力し、乗算部５６ｅ21～５６ｅ2nは各符号多重信号ｘｉ(t)に抑圧係数ｚ・ｗｉを乗算してセレクタ５６ｅ31～５６ｅ3nに入力する。

【００３２】セレクタ５６ｅ31～５６ｅ3nは、(1) 抑圧タイミングでない時(振幅抑圧不要時)、各符号多重信号ｘｉ(t)をそのまま出力し、(2) 抑圧タイミング時(振幅抑圧必要時)、乗算部５６ｅ21～５６ｅ2nの乗算結果を出力する。すなわち、セレクタ５６ｅ31～５６ｅ3nは振幅抑圧不要時、各符号多重信号ｘｉ(t)を抑圧することなくそのまま出力し、振幅抑圧必要時、キャリア多重信号のピーク値に与える影響が大きい符号多重信号ほど信号振幅を抑圧して出力する。この結果、振幅の小さな符号多重信号をあまり抑圧しないから、該小振幅信号の信号劣化（変調精度の劣化）を防止することができる。抑圧タイミング信号ALSは、抑圧係数演算部５５（図８）より出力される。すなわち、抑圧係数演算部５５はキャリア多重信号の振幅が設定値ｖｃ以下であれば抑圧係数ｚ＝１を出力すると共に抑圧タイミング信号ALSを発生せず、設定値以上であれば、所定の抑圧係数ｚ（＜１）を出力すると共に、抑圧タイミング信号ALSを出力する。

【００３３】図１０の振幅制御部において、抑圧係数重み付け部５６ｆ1は各符号多重信号ｘｉ(t)の振幅を比較し、キャリア多重信号のピーク値に対する影響が大きい信号ほど、たとえば、信号振幅が大きい符号多重信号ほど、抑圧係数が小さくなるような重みを決定し、抑圧係数ｚに重みｗｉを掛けたものを出力する。セレクタ５６ｆ21～５６ｆ2nは、(1) 抑圧タイミングでない時(振幅抑圧不要時)、１を選択して各乗算部５６ｆ31～５６ｆ3nに出力し、(2) 抑圧タイミング時(振幅抑圧必要時)、重み付け部５６ｆ1から出力する重み付け抑圧係数を各乗算部５６ｆ31～５６ｆ3nに出力する。この結果、乗算部５６ｃ11～５６ｃ1nは振幅抑圧不要時、各符号多重信号ｘｉ(t)を抑圧することなくそのまま出力し、振幅抑圧必要時、各符号多重信号ｘｉ(t)に重み付け抑圧係数を乗算して抑圧した信号を出力する。以上より、振幅抑圧必要時、キャリア多重信号のピーク値に与える影響が大きい符号多重信号ほど信号振幅を抑圧し、振幅の小さな符号多重信号をあまり抑圧しないようにできる。

【００３４】（Ｃ）第３実施例

図１１は複数の符号多重信号をキャリア多重して送信する本発明の第３実施例の構成図であり、図１の第１実施例と同一部分には同一符号を付している。第３実施例では、ピーク検出系において振幅制限前と振幅制限後のキャリア多重信号の差分を演算し、該差分をキャリア数分の１にした共通の振幅抑圧信号を作成し、主信号系の帯域制限フィルタ前において、該振幅抑圧信号を各符号多重信号より減算してキャリア多重信号のピークを抑圧する。

【００３５】マルチキャリアピーク検出回路５４において、周波数シフト部５４ａ1～５４ａnは符号多重信号ｘ1(t)，ｘ2(t)，．．．ｘn(t)に周波数ｆ1～ｆnのキャリア信号を乗算して周波数シフトし、合成部５４ｂは周波数シフトされた各符号多重信号を周波数多重してキャリア多重信号Ａ・exp(jθ)を出力する。振幅制限部５７は、図１２に示すようにキャリア多重信号が設定振幅ｖｃとなるように振幅制限してｖｃ・exp(jθ)を出力する。差分演算部５８はキャリア多重信号Ａ・exp(jθ)とｖｃ・exp(jθ)の差分ｚ（＝（Ａ－ｖｃ）exp(jθ)）を演算し、除算部５９は差分ｚをキャリア数（＝ｎ）分の１して、振幅抑圧信号ｚａ（＝ｚ／ｎ）を発生して振幅制御部５６に入力する。振幅制御部５６の減算部５６ｇ1～５６ｇnは、各符号多重信号ｘ1(t)，ｘ2(t)，．．．ｘn(t)からそれぞれ振幅抑圧信号ｚａを減算してキャリア多重信号のピークを抑圧する。

【００３６】・振幅制御部の変形例

図１３は振幅制御部５６の変形例であり、図１１の差分信号ｚを符号多重信号ｘ1(t)，ｘ2(t)，．．．ｘn(t)の振幅値に基づいて重み付けし、各符号多重信号ｘ1(t)，ｘ2(t)，．．．ｘn(t)より重み付けした振幅抑圧信号ｚａ1～ｚａnを減算してピークを抑圧する。すなわち、重み付け部５６ｈ1は各符号多重信号ｘｉ(t)の振幅を比較し、キャリア多重信号のピーク値に対する影響が大きい信号ほど、たとえば、信号振幅が大きい符号多重信号ほど、振幅抑圧信号が大きくなるように重みを決定して出力する。ただし、重みの総和が１になるようにする。乗算部５６ｈ21～５６ｈ2nは差分信号ｚに重みを乗算して重み付け振幅抑圧信号ｚａ1～ｚａnを発生する。減算部５６ｈ31～５６ｈ3nは、各符号多重信号ｘ1(t)～ｘn(t)からそれぞれ重み付けした振幅抑圧信号ｚａ1～ｚａnを減算してキャリア多重信号のピークを抑圧する。この変形例の振幅制御部によれば、キャリア多重信号のピーク値に与える影響が大きい符号多重信号ほど信号振幅を抑

圧し、振幅の小さな符号多重信号をあまり抑圧しないようにできる。この結果、小振幅の符号多重信号の信号劣化（変調精度の劣化）を防止することができる。

【００３７】・第３実施例の変形例

図１４は第３実施例の変形例であり、図１１の第３実施例と同一部分には同一符号を付している。異なる点は、①差分信号ｚを１／ｎする除算部５９の後段に帯域制限用のフィルタ６０を設けた点、②主信号系のフィルタ６４の後段に振幅制御部５６を設けている点、③主信号系において遅延部６３(図１１参照）を省略している点である。尚、遅延部を付加することは当然可能である。以上の構成により、差分信号ｚを１／ｎして得られる振幅抑圧信号ｚａをフィルタ６０により波形整形する。しかる後、振幅制御部５６において、主信号系のフィルタ６４で帯域制限された符号多重信号$x_i(t)$よりフィルタ６０の出力信号を減算してキャリア多重信号のピークを抑圧する。

【００３８】かかる構成にすれば、主信号系のフィルタ６４の特性によりオーバシュートが発生して設定値を越えても、該フィルタの後で振幅制限しているため確実にピークを設定値以下に抑圧することができる。又、振幅抑圧信号ｚａをフィルタリングすることにより振幅制御は単なるスペクトルの重ね合わせになり、フィルタ６０の特性を適当に設計することにより信号劣化を少なくしながらピーク抑圧が可能になる。すなわち、変形例によれば、ピーク抑圧信号の帯域制限フィルタを主信号系の帯域制御フィルタと独立に制御し、ピーク抑圧信号の帯域制限フィルタを適当な特性に設定することにより、若干のスペクトルの劣化を許容することで、より大きなピーク抑圧ができる。

【００３９】・付記

（付記１）符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置において、複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部、を備え、前記振幅制御部は、第２のキャリア多重信号のピーク値に与える影響の大きい符号多重信号を選択する選択部、第２のキャリア多重信号の振幅が設定値を越えたとき、前記選択された符号多重信号に抑圧係数を乗算して第１のキャリア多重信号のピークを抑圧する信号抑圧部、を備えたことを特徴とする符号多重信号送信装置。

【００４０】（付記２）符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置において、複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部、を備え、前記振幅制御部は、第２のキャリア多重信号の振幅が設定値を越えたとき、前記符号多重信号の振幅を抑圧する抑圧係数を決定する抑圧係数決定部、各符号多重信号の振幅に応じて抑圧係数の重み付けを行う重み付け部、前記第２のキャリア多重信号の振幅が設定値を越えたとき、前記各符号多重信号に前記重み付けされた抑圧係数を乗算して第１のキャリア多重信号のピークを抑圧する信号抑圧部、を備えたことを特徴とする符号多重信号送信装置。

（付記３）抑圧が必要な時刻に符号多重信号に対して抑圧係数を乗算してキャリア多重信号のピーク値を抑圧する、ことを特徴とする付記１又付記２記載の符号多重信号送信装置。

【００４１】（付記４）符号多重信号をキャリア多重し、該キャリア多重信号を増幅して送信する符号多重信号送信装置において、複数の符号多重信号をキャリア多重して第１のキャリア多重信号を生成し、該第１のキャリア多重信号を増幅して送信する第１のキャリア多重回路、前記複数の符号多重信号をキャリア多重する第２のキャリア多重回路、前記第２のキャリア多重回路から出力する第２のキャリア多重信号の振幅を監視し、該信号振幅が設定値を越えたとき、第１のキャリア多重回路におけるキャリア多重前の前記符号多重信号の振幅を抑圧する振幅制御部、を備え、前記振幅制御部は、第２のキャリア多重信号の振幅値が設定値を越えたとき、該キャリア多重信号の振幅と設定値との差分を演算する演算部、該差分を等分し、あるいは、符号多重信号の振幅に応じて重み付けして配分して振幅抑圧信号を生成する手段、前記第２のキャリア多重信号の振幅が設定値を越えたとき、前記各符号多重信号より前記振幅抑圧信号を減算してキャリア多重信号のピークを抑圧する信号抑圧部、を備えたことを特徴とする符号多重信号送信装置。

【００４２】（付記５）前記振幅制御部は、前記振幅抑圧信号に波形整形を施すフィルタを備え、前記信号抑圧部は、第１のキャリア多重回路の帯域制限フィルタより出力する各符号多重信号より前記波形整形された振幅抑圧信号を減算する、ことを特徴とする付記４記載の符号多重信号送信装置。

【００４３】

【発明の効果】以上本発明によれば、キャリア多重信号のピーク抑圧において、主信号系のキャリア多重部とは別のピーク検出用のキャリア多重回路を設け、これを用

いてキャリア多重信号のピークを検出してキャリア多重前の信号振幅を制御するようにしたから、キャリア多重信号のスペクトル特性を劣化させることなく、キャリア多重信号のピークを抑圧でき、しかも、本発明によれば、ピーク検出時間を短縮できるため、短時間の遅延部を設けるなどしてピーク抑圧前の信号が電力増幅器に入力しないようにできる。

【００４４】本発明によれば、個々の符号多重信号の振幅を制御してキャリア多重信号のピークを抑圧する場合、ピークに影響を与える大振幅の符号多重信号のみ振幅抑圧し、あるいは、ピークに影響を与える振幅の大きさに基づいて抑圧量を重み付けするため、キャリア多重信号のピーク抑圧制御により小振幅の符号多重信号が劣化（変調精度の劣化）しないようにできる本発明によれば、抑圧が必要な時刻の符号多重信号に対して抑圧係数を乗算してキャリア多重信号のピーク値を抑圧するようにしたから、ピーク抑圧を簡単に行うことができる。本発明によれば、ピーク抑圧信号を符号多重信号より減算するように構成し、かつ、ピーク抑圧信号の帯域制限フィルタを主信号系の帯域制御フィルタと独立に制御し、ピーク抑圧信号の帯域制限フィルタを適当な特性に設定するようにしたから、若干のスペクトルの劣化を許容することで、より大きなピーク抑圧ができる。

【図面の簡単な説明】

【図１】複数の符号多重信号をキャリア多重して送信する第１実施例の符号多重信号送信装置の構成図である。

【図２】チップ整形フィルタの特性説明図である。

【図３】符号多重信号の説明図である。

【図４】第１実施例の第１変形例である。

【図５】第１実施例の第２変形例である。

【図６】振幅制御回路の第１変形例である。

【図７】振幅制御回路の第２変形例である。

【図８】第２実施例の符号多重信号送信装置の構成図である。

【図９】図８の振幅制御回路の第１変形例である。

【図１０】図８の振幅制御回路の第２変形例である。

【図１１】第３実施例の符号多重信号送信装置の構成図である。

【図１２】振幅制限部の動作説明図である。

【図１３】振幅制御回路の変形例である。

【図１４】第３実施例の変形例である。

【図１５】従来のＣＤＭＡ送信機の構成図である。

【図１６】電力増幅器のＡＭ－ＡＭ特性（入力パワー／ゲイン特性）である。

【図１７】電力増幅器のＡＭ－ＰＭ特性（入力パワー／位相特性）である。

【図１８】ピーク抑圧部を備えた従来の符号多重信号送信装置の構成図である。

【図１９】従来の複数の符号多重信号をキャリア多重して送信する符号多重信号送信装置の構成図である。

【符号の説明】

５１₁～５１ｎ　符号多重信号送信部

５２　加算部

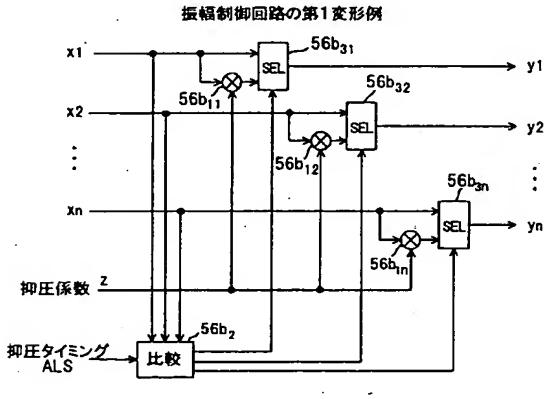
５３　電力増幅器

５４　マルチキャリアピーク検出回路

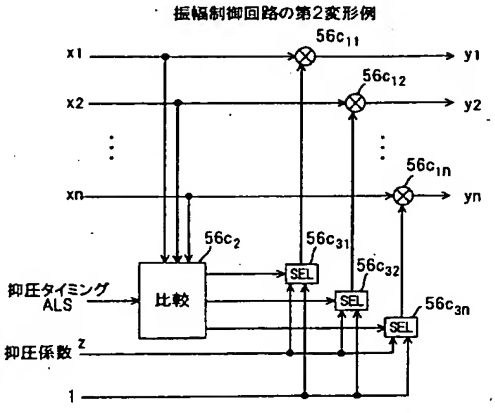
５５　抑圧係数演算部

５６　振幅制御部

【図６】

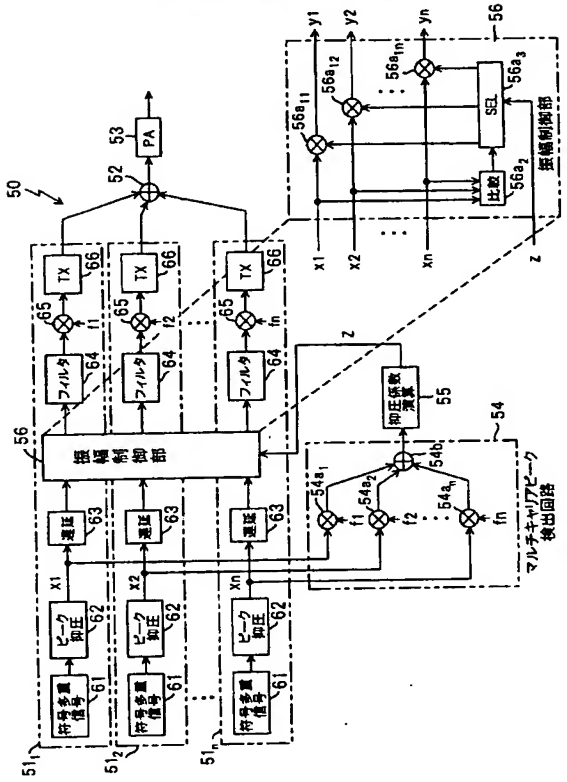


【図７】



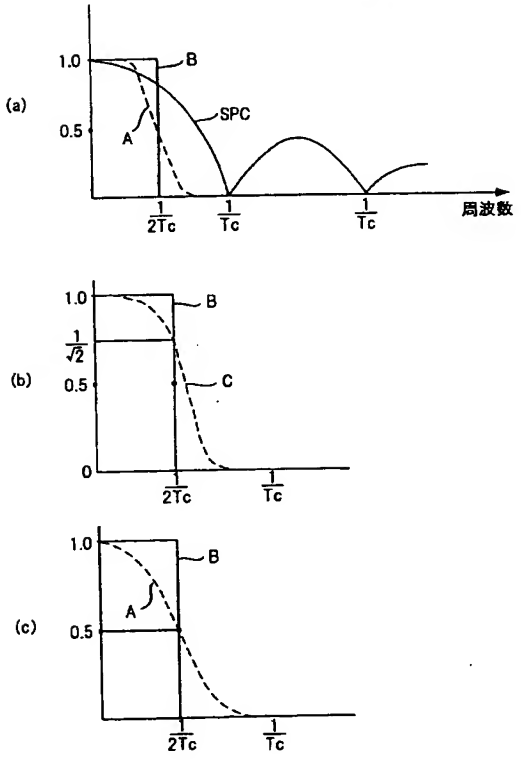
【図１】

第1実施例の符号多重信号送信装置の構成



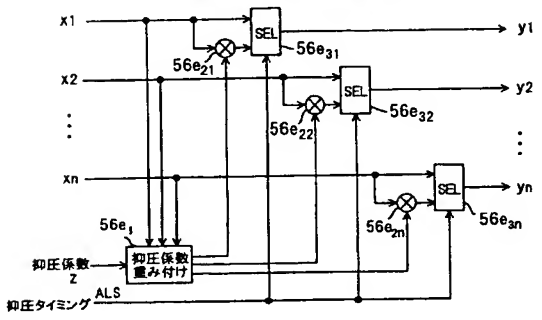
【図２】

チップ整形フィルタの特性説明図



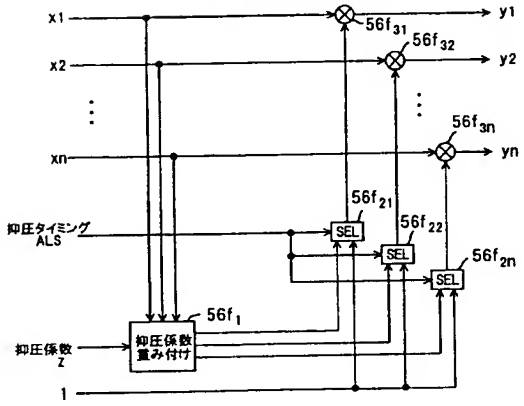
【図９】

振幅制御回路の第1変形例



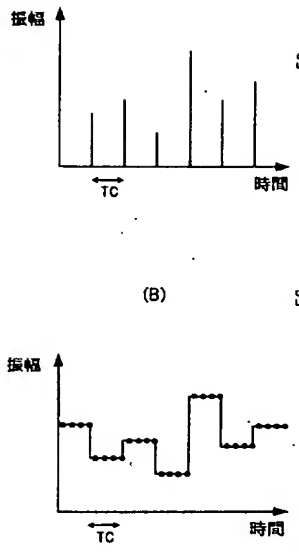
【図１０】

振幅制御回路の第2変形例



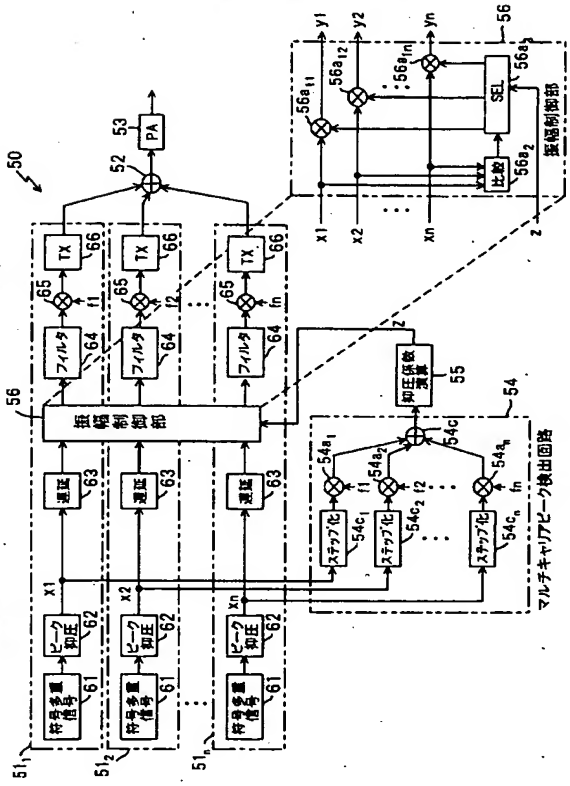
【図３】

符号多重信号説明図



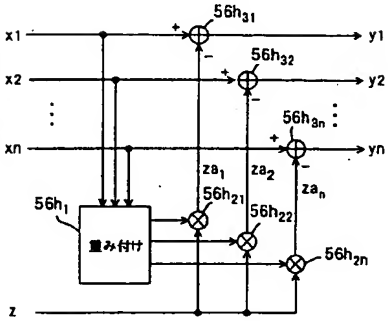
【図４】

第1実施例の第1変形例



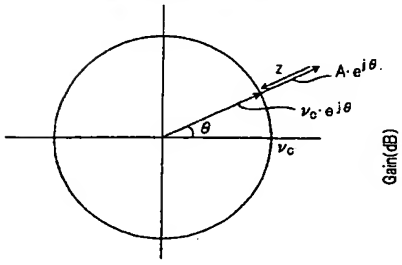
【図１３】

振幅制御回路の変形例



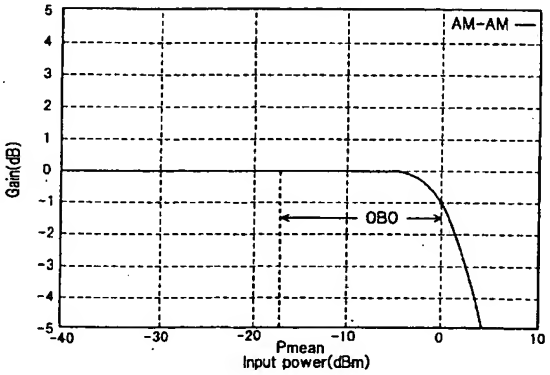
【図１２】

振幅制限部の動作説明図

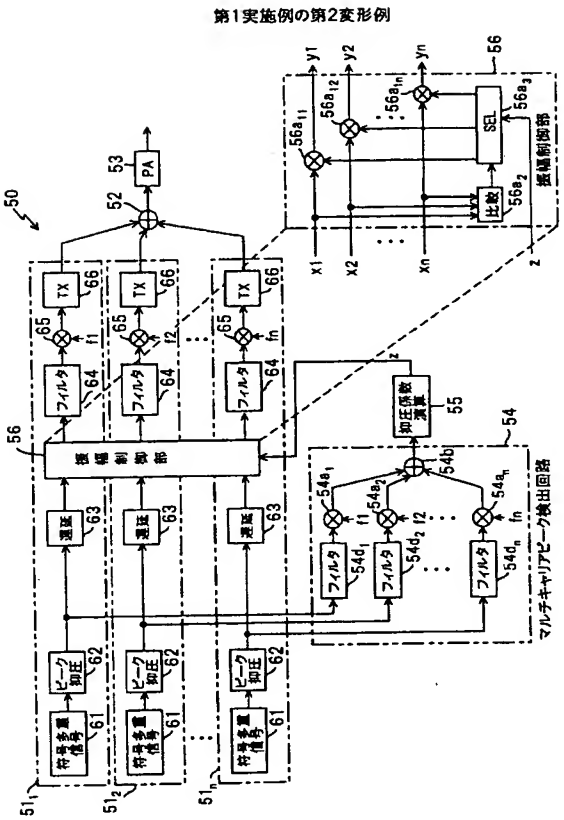


【図１６】

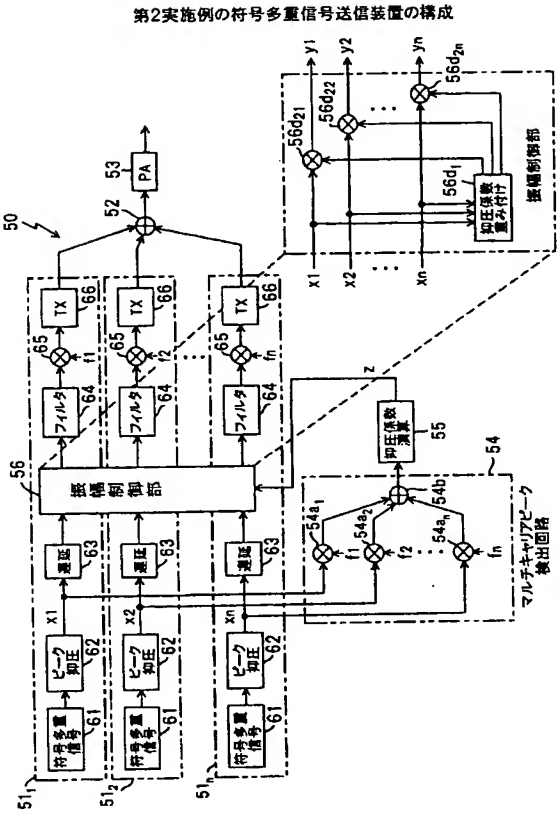
アンプのAM-AM特性



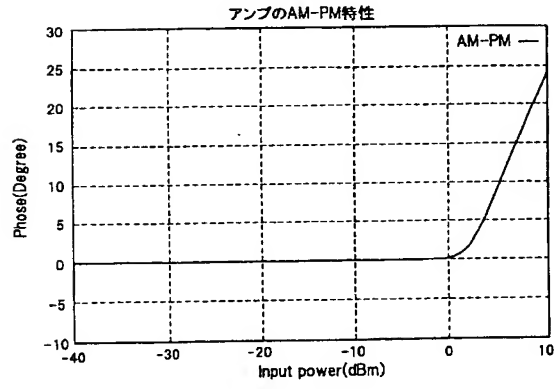
【図５】


第1実施例の第2変形例
符号多重信号
ピーク抑圧
遅延
フィルタ
TX
PA
振幅制御部
抑圧係数演算
比較
SEL
マルチキャリアピーク検出回路

【図８】

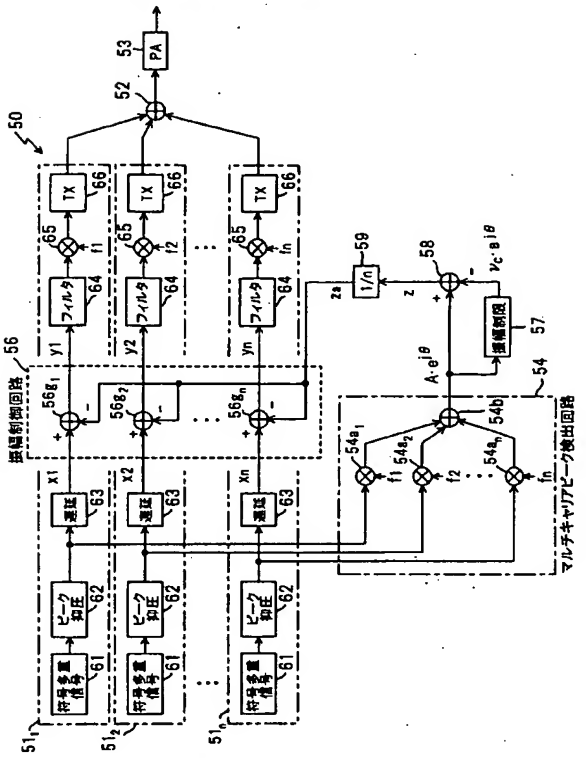

第2実施例の符号多重信号送信装置の構成
符号多重信号
ピーク抑圧
遅延
フィルタ
TX
PA
振幅制御部
抑圧係数演算
抑圧係数重み付け
マルチキャリアピーク検出回路

【図１７】


アンプのAM-PM特性
AM-PM
Phase(Degree)
Input power(dBm)
30
25
20
15
10
5
0
-5
-10
-40
-30
-20
-10
0
10

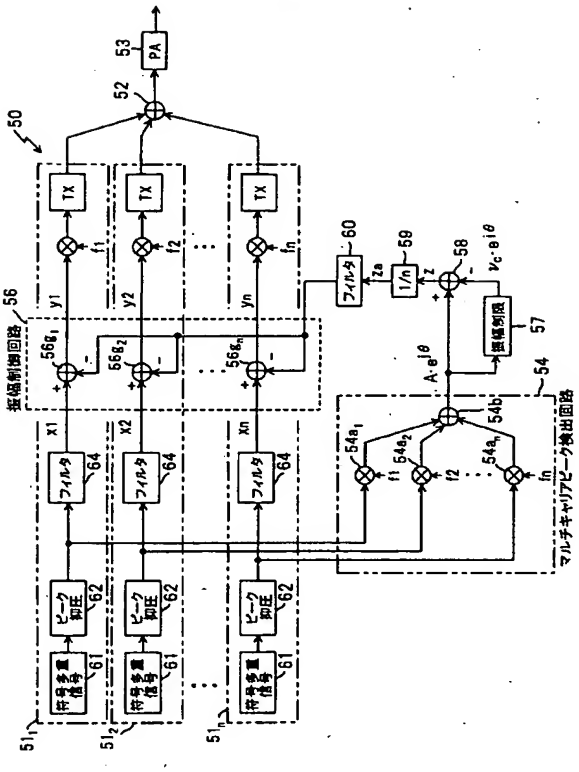
【図１１】

第3実施例の符号多重信号送信装置の構成



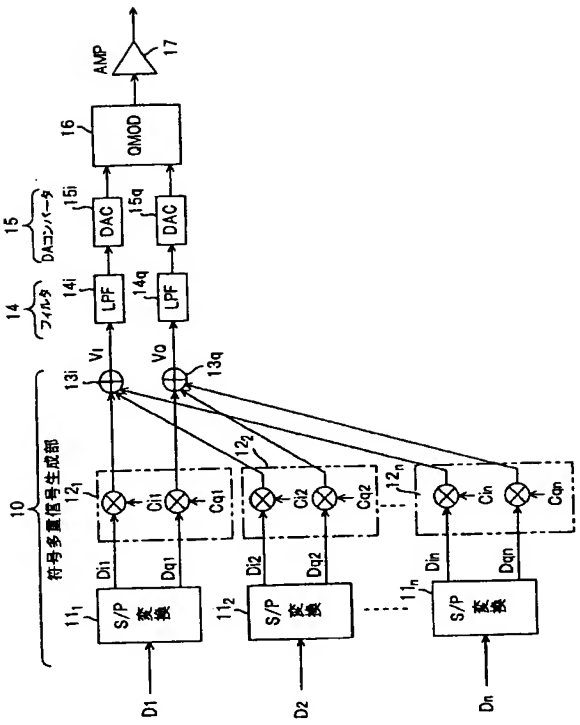
【図１４】

第3実施例の変形例



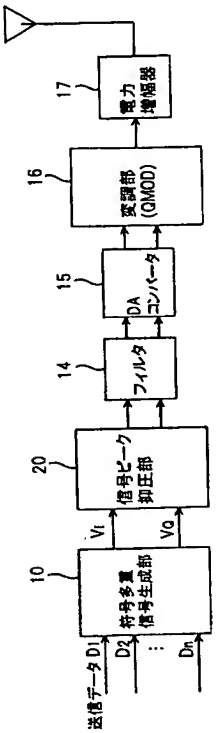
【図１５】

従来のCDMA送信機の構成



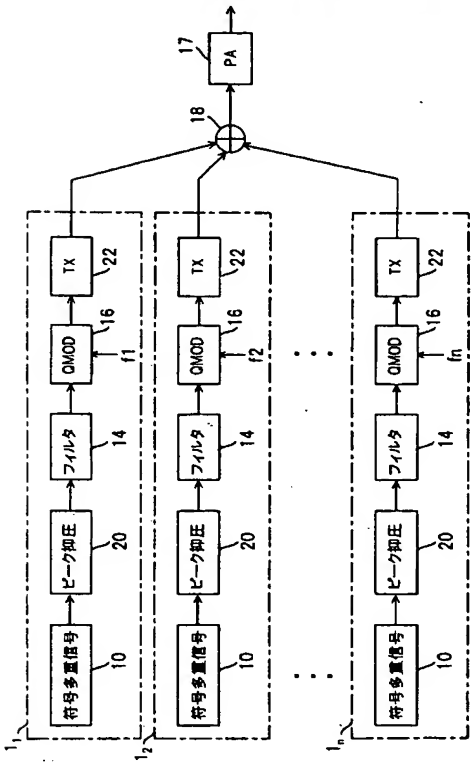
【図１８】

ピーク抑圧部を備えた従来の符号多重信号送信装置



【図１９】

従来の複数キャリアの符号多重信号送信装置の構成



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EE22